

SEPTEMBER 1995

Video on  
Demand  
Begins after p. 32

# BYTE

THE MAGAZINE OF TECHNOLOGY INTEGRATION

**Revealed! When the P6 Is  
Slower than the Pentium** P. 24

**Telephony's Killer App** P. 215

**CompuServe, AOL, Prodigy:  
Which Wins Web War?** P. 229

**best**  
**COMPUTERS**  
**top**  
**PROGRAMS**  
**biggest**  
**TECHNOLOGIES**  
**most**  
**influential**  
**PEOPLE**

**plus!**

**Weirdest** Error Messages  
**Worst** Bugs  
**Amazing** Hacker Feats  
**AND MORE...**

# YEARS

9 770360 528018





## P133 MILLENNIA PLUS

- Intel 133MHz Pentium® processor
- 256K Micron SyncBurst™ cache, Flash BIOS
- PCI 32-bit Fast SCSI-2 controller
- 6X SCSI-2 CD-ROM drive, 3.5" floppy
- SoundBlaster 16 stereo sound & speakers
- PCI 64-bit graphics accelerator (2MB)
- Tool-Free mini-tower or desktop
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups CD
- MS Office Pro 4.3 & MS Bookshelf CDs

**A** • 16MB EDO RAM • 1GB SCSI-2 hard drive  
 • 15" Micron 15FGx, 1280NI, .28mm  
**\$3,499** (Business Lease \$119/month)

**B** • 32MB EDO RAM • 2GB SCSI-2 hard drive  
 • 15" Micron 15FGx, 1280NI, .28mm  
**\$4,499** (Business Lease \$153/month)

**C** • 64MB EDO RAM • 4GB SCSI-2 hard drive  
 • 17" Micron 17FGx, 1280NI, .28mm  
**\$6,499** (Business Lease \$213/month)

**D** • 128MB EDO RAM • 9GB SCSI-2 hard drive  
 • 21" Micron 21FGx, 1600NI, .28mm  
**\$11,499** (Business Lease \$369/month)  
 \*Option D not available in desktop

## P75 POWERSTATION

- Intel 75MHz Pentium processor
- 256K write-back cache, Flash BIOS
- 4X EIDE CD-ROM drive, 3.5" floppy
- SoundBlaster 16 stereo sound & speakers
- PCI 64-bit graphics accelerator (2MB)
- Tool-Free mini-tower or desktop
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups CD

**A** • 8MB EDO RAM • 850MB EIDE hard drive  
 • 15" Micron 15FGx, 1028NI, .28mm  
 • MS Works Multimedia CD  
**\$1,899** (Business Lease \$71/month)

**B** • 16MB EDO RAM • 1.2GB EIDE hard drive  
 • 15" Micron 15FGx, 1280NI, .28mm  
 • MS Office Pro 4.3 & MS Bookshelf CDs  
**\$2,399** (Business Lease \$85/month)

**C** • 32MB EDO RAM • 1.6GB EIDE hard drive  
 • 17" Micron 17FGx, 1280NI, .28mm  
 • MS Office Pro 4.3 & MS Bookshelf CDs  
**\$3,499** (Business Lease \$119/month)

• With 90MHz Pentium processor.....add \$100  
 • With 100MHz Pentium processor.....add \$200

## P90 POWERSTATION

- Intel 90MHz Pentium processor
- 256K write-back cache, Flash BIOS
- 4X EIDE CD-ROM drive, 3.5" floppy
- SoundBlaster 16 stereo sound & speakers
- PCI 64-bit graphics accelerator (2MB)
- Tool-Free mini-tower or desktop
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups CD

• With 100MHz Pentium processor.....add \$100

**A** • 8MB EDO RAM • 850MB EIDE hard drive  
 • 15" Micron 15FGx, 1280NI, .28mm  
 • MS Works Multimedia CD  
**\$1,999** (Business Lease \$71/month)

**B** • 16MB EDO RAM • 1.2GB EIDE hard drive  
 • 15" Micron 15FGx, 1280NI, .28mm  
 • MS Office Pro 4.3 & MS Bookshelf CDs  
**\$2,499** (Business Lease \$89/month)

## STELLAR PERFORMANCE

**M**icron is fast becoming the industry leader in personal computer design, engineering and manufacturing.

Right off the production line,

Micron PCs are receiving awards and critical acclaim for exceptional quality, record-breaking speed and dependable performance.

Everywhere you turn, Fortune

500 corporations, mid-size busi-

nesses and home offices are dis-

covering the benefits of buying a

Micron computer.

## P133 POWERSERVER SMP

- Intel 133MHz Pentium processor
- Dual Pentium SMP ZIF sockets
- 512K write-back cache, Flash BIOS
- Slots: 5 EISA, 2 PCI, 1 EISA/PCI
- PCI 32-bit Fast SCSI-2 controller
- 4X SCSI-2 CD ROM drive, 3.5" floppy
- PCI 64-bit graphics accelerator (2MB)
- Full-size tower with 10 drive bays
- Microsoft Mouse, 101-key keyboard
- MS DOS & Windows for Workgroups CD

**A** • 16MB RAM • 1GB SCSI-2 hard drive  
 • 15" Micron 15FGx, 1280NI, .28mm  
**\$3,999** (Business Lease \$136/month)

**B** • 32MB RAM • 2GB SCSI-2 hard drive  
 • 15" Micron 15FGx, 1280NI, .28mm  
**\$4,999** (Business Lease \$170/month)

• With second 133MHz Pentium processor.....add \$999  
 • With Windows NT Workstation CD.....add \$249



May 30, 1994  
P120 MILLENNIA



June 28, 1994  
P90PCI  
POWERSTATION



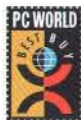
May 16, 1995  
P90 HOME MPC



July 1995  
P90 HOME MPC



February 1995  
P90 HOME MPC



October 1994  
P90PCI  
POWERSTATION



pentium



When  
your  
486 just  
doesn't  
cut it.



# P133 HOME MPC PRO

*The Ultimate Home Office Performance System*

## P133 HOME MPC PRO

- Intel 133MHz Pentium® processor
- 256K Micron SyncBurst™ cache, Flash BIOS
- 16MB EDO RAM, 1.2GB EIDE hard drive
- 4X EIDE CD-ROM drive, 3.5" floppy
- SoundBlaster™ 16 stereo sound & speakers
- 14.4 Fax/Modem, speakerphone, voice mail
- PCI 64-bit graphics accelerator (2MB)
- 17" Micron 17FGx, 1280NI, .28mm
- Tool-Free mini-tower or desktop
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups CD
- MS Office Pro 4.3 & MS Bookshelf CDs
- Microsoft Scenes: Sports Extremes; Microsoft Bob CD; Microsoft Encarta 95 CD; Quicken Deluxe Edition CD; Microsoft Dangerous Creatures CD; Microsoft Golf Multimedia CD; Trial Subscriptions for CompuServe, America OnLine & Prodigy.

**\$3,499**



May 16, 1995  
P90 HOME MPC



July 1995  
P90 HOME MPC



## P75 HOME MPC

- Intel 75MHz Pentium processor
- 256K write-back cache, Flash BIOS
- 8MB EDO RAM, 850MB EIDE hard drive
- 4X EIDE CD-ROM drive, 3.5" floppy
- SoundBlaster™ 16 stereo sound & speakers
- 14.4 Fax/Modem, speakerphone, voice mail
- PCI 64-bit graphics accelerator (2MB)
- 15" Micron 15FGx, 1280NI, .28mm
- Tool-Free mini-tower or desktop
- Microsoft Mouse, 101-key keyboard
- MS-DOS & Windows for Workgroups CD
- Microsoft Works Multimedia CD
- Microsoft Scenes: Sports Extremes; Microsoft Bob CD; Microsoft Encarta 95 CD; Quicken Deluxe Edition CD; Microsoft Dangerous Creatures CD; Microsoft Golf Multimedia CD; Trial Subscriptions for CompuServe, America OnLine & Prodigy.

**\$1,999**

- With 90MHz Pentium processor.....add \$100
- With 100MHz Pentium processor.....add \$200

Micron Electronics, Inc., 900 E. Karcher Road, Nampa, ID 83687 • Mon-Fri 7AM-8PM Sat 8AM-5PM (MT)  
208-463-3434 • FAX 208-463-3424 • Purchase Order FAX 208-467-5384

International Sales  
208-465-8970



International FAX  
208-465-8993



From Mexico Call  
95-800-708-1755



From Puerto Rico Call  
800-708-1756



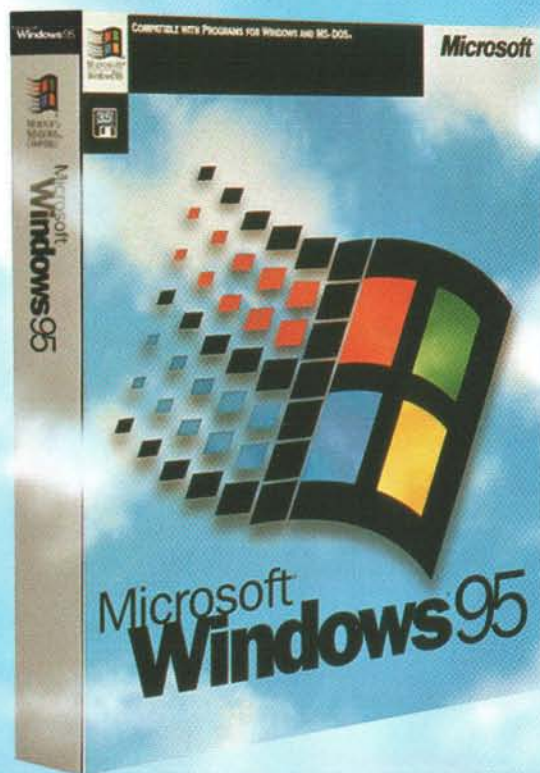
From Canada Call  
800-708-1758

© 1996 Micron Electronics, Inc. All rights reserved. All prices and specifications subject to change without notice. Micron Electronics, Inc. cannot be responsible for omissions and/or errors in typography or photography. "Mark Your Place With The Leader" is a service mark of Micron Electronics, Inc. Intel, Intel Inside, and Pentium are registered trademarks of the Intel Corporation. Microsoft is a registered trademark and Windows, Windows NT and the Windows logos are trademarks of Microsoft Corporation. All other company trademarks are trade names of each respective company. Prices do not include shipping and handling. 30-day risk-free money back guarantee does not include return freight and original shipping/handling charges, applies only to Micron brand products, and begins from date of shipment. All returns require FMA numbers and must be shipped in the original condition pre-paid and insured. Lease prices based on 36-month lease.

**It's Your Call!**  
**800-233-7027**  
**MICRON**  
ELECTRONICS, INC.



# THE FUTURE OF WINDOWS



**MICRON**  
ELECTRONICS, INC.





# THE MICRON MILLENNIA

*"Buyers looking for the fastest system money can buy will find it in the Micron Millennium."*

PC Week, May, 1995

And the reason for the Micron P120 Millennium's amazing ability to far outperform the competition? It's exclusive dynamic combination of Micron's EDO (Extended Data Out)

Memory and SyncBurst™ cache, providing significant performance gains over previous memory designs. Once again, another major breakthrough in computing performance innovation from Micron, the technology leader.

## P120 MILLENNIA

- Intel 120MHz Pentium® processor
- 256K Micron SyncBurst cache, Flash BIOS
- 4X EIDE CD-ROM drive, 3.5" floppy drive
- SoundBlaster™ 16 stereo sound & speakers
- PCI 64-bit graphics accelerator (2MB)
- Tool-free mini-tower or desktop
- Microsoft® Mouse, 101-key keyboard
- MS-DOS® & Windows® for Workgroups CD

### A • 8MB EDO RAM, 850MB EIDE hard drive

- 15" Micron 15FGx, 1280NI, .28mm
- Microsoft Works Multimedia CD

**\$2,499** (Business Lease \$89/month)

### B • 16MB EDO RAM, 1.2GB EIDE hard drive

- 15" Micron 15FGx, 1280NI, .28mm
- Microsoft Office Pro 4.3 & MS Bookshelf CDs

**\$2,999** (Business Lease \$107/month)

### C • 32MB EDO RAM, 1.6GB EIDE hard drive

- 17" Micron 17FGx, 1280NI, .28mm
- Microsoft Office Pro 4.3 & MS Bookshelf CDs

**\$4,099** (Business Lease \$140/month)

• P133 MILLENNIA.....add **\$100**

*"The Millennium is nothing short of the best all-around PC available on the Market today."*

PC Magazine, April 25, 1995



May 30, 1995  
P120 MILLENNIA

According to PC Magazine's most recent Windows based tests, the Micron P120 Millennium is a "star performer." The Millennium garnered the

highest Graphics WinMark score ever seen, in addition to a top-notch Winstone score.



**MICRON**

**800-222-2222**



This yard with **no fences**

brought to you by new Microsoft Office





# Microsoft®

WHERE DO YOU WANT TO GO TODAY?™



Announcing new Microsoft® Office for Windows® 95.  
Software that doesn't hold you back. Software that presents fewer obstacles.

Five integrated applications, one entirely new approach to the way they work.  
It's not merely an "upgrade." It's not just about new features and new buttons.  
It's about easier, more intuitive access to capabilities old and new.  
Software that speaks your language, that answers your questions.

Now you have a suite of productivity programs designed to take advantage of Windows 95.  
Programs that let you focus on your work, not on your software.





# 20 YEARS

## SPECIAL ISSUE

Message from the Editor.....	53
Top 20 Small Systems .....	54
Top 20 Software Products .....	64
Most Important Chips.....	74
Most Important Networking Products.....	79
The Best Things On-line.....	85
Most Important Companies.....	99
Top 20 Technologies.....	109
Notorious Bugs .....	125
The 20 Most Important People.....	133
20 Spectacular Failures .....	145
Noted and Notorious Hacker Feats.....	151

## Features

### MANAGEMENT

#### Assets on the Line.....37

BY SALVATORE SALAMONE

You can cut support costs if you've got an inventory of hardware and software.

### REMOTE ACCESS

#### You Can Take It with You.....41

BY JEFFREY FRITZ

So you're working in Hooterville and that file you need is on a server at the home office in Chicago. No problem. With digital services like ISDN, and even analog technology, you can connect to the corporate network.



## State of the Art

### COMPUTER TELEPHONY

#### Collision!.....199

BY RUSSELL KAY

Tying together telephones and computers is a great concept. New technologies, products, and standards are finally taking computer telephony beyond the concept stage and into your office.



#### Standard Issue.....201

BY JAMES BURTON

When there was just one phone company, standards and interoperability weren't even questions. Now we've got multiple answers.

Strategic Industry Alliances—203  
A Checklist for Making CTI Decisions—206



#### Building Telephony Applications.....211

BY JAMES BURTON

As more organizations use computer telephony, those that don't may be at a competitive disadvantage. Here's a guide to development tools you'll need to construct computer telephony systems.



#### Telephony's Killer App.....215

BY JOHN P. MELLO JR.

It's going to take unique software to make telephony a gotta-have-it resource. Here are some of the contenders that might be natural-born killers, including PhoneNotes, FastCall, and VoiceView.

Wildfire: One Wild and Not-So-Crazy Helper—216

## News & Views

### PROCESSORS

#### P6 Weakness Revealed.....24

People who buy the first computers based on Intel's P6 processor will be in for a surprise when they run 16-bit DOS and Windows applications. According to benchmarks, a Pentium runs 16-bit DOS/Windows programs *faster* than a P6 at the same clock speed, even though the next-generation P6 is supposed to be a "faster" CPU.

### LITTLE THINKING MACHINES

#### PC Power Comes to the Calculator...25

Texas Instruments plans to release a new calculator that's a whole lot smarter than its predecessors.

### WINDOWS DEVELOPMENT

#### Delphi and VB Turn 32.....26

New versions of Borland's Delphi and Microsoft's Visual Basic have stronger client/server and OLE development capabilities for 32-bit programs.



## Reviews

### ON-LINE SERVICES

#### Gateways to the Internet.....229

BY GEORGE BOND

A veteran Internet roamer finds that the Big Three on-line services offer adequate but pricey gateways to the Net.

Convenience, but at What Price?—229

MSN: Desktop Internet—231

### NOTEBOOK COMPUTERS

#### Presentation Quality.....233

BY EDMUND X. DEJESUS

IBM's slick new screen technology turns the ThinkPad 755CV into a remote-control color presentation panel.

### OPERATING SYSTEMS

#### Networking at Warp Speed.....235

BY BARRY NANCE

If OS/2's technical advantages don't wow you, maybe Warp Connect's networking goodies

will. This 32-bit OS bundle includes peer services, LAN requesters, a slick approach to over-the-wire installation, and a passel of handy programs.

### COLOR PRINTERS

#### To Print a Rainbow.....239

BY TOM THOMPSON

Second-generation color lasers from Apple and Tektronix set new standards for print quality, network connectivity, and ease of maintenance.

### GRAPHICS ACCELERATORS

#### 3-D Graphics Go Zoom.....243

BY GREG LOVERIA

Intergraph and Omnicomp offer two different routes to the land of glorious photo-realistic images—a workstation and a plug-in PC card.

### DISK ARRAYS

#### Lab Report:

#### 16 Fast, Reliable RAID Subsystems.....248

We test a wide array of disk subsystems that minimize network downtime and maximize storage space, then pick the best RAIDs for database servers and audio/video applications.

How Error Correction Works—250

File Servers with RAID—252

How We Tested—254

Software RAID Solutions—256

Honorable Mentions—259

Helpful Hints—259



## Core Technologies

### CPU'S

#### Endian Issues.....263

BY WILLIAM STALLINGS

Different processors have incompatible memory-storage arrangements, but the PowerPC can handle them all.

### PROGRAMMING

#### The Joy of J.....267

BY DICK POUNTAIN

Successor to APL, the J language extends its ancestor's expressiveness and power. And you don't need a special keyboard.

### OPERATING SYSTEMS

#### Springtime at Sun.....271

BY DOUG TAMASANIS

Many of the concepts in Sun's experimental Spring system will bloom in Solaris.

### NETWORKS

#### Tuning In to ISDN.....273

BY JEFFREY FRITZ

Satellite and radio technology are breaking the earthly limits of terrestrial ISDN.

### International Section... 321S 1

#### Reader Survey.....282

#### READER SERVICE

Editorial Index by Company.....328  
Alphabetical Index to Advertisers ... 329

#### Index to Advertisers by

Product Category .....326  
Inquiry Reply Cards .....132A, 326A

#### BUYER'S GUIDE.....291

Mail Order  
Hardware/Software Showcase  
Buyer's Mart

#### PROGRAM LISTINGS

FTP: ftp to ftp.byte.com

From BIX: Join  
"listings/frombyte95" and select  
the appropriate subarea (i.e.,  
"sep95."

From the BYTE BBS at 1200-9600  
bps: Dial (603) 924-9820 and  
follow the instructions at the  
prompt.

Bulk Rate  
US Postage  
PAID  
McGraw-Hill

Third class mail enclosed, edition  
codes: W1C, W1D, W1E, W1F,  
W1G

BYTE (ISSN 0360-5280) is published monthly by McGraw-Hill, Inc. U.S. subscriber rate \$29.95 per year. In Canada and Mexico, \$34.95 per year. European surface mail subscriptions \$60, airmail \$85. Non-European subscriptions, \$60 surface mail or \$85 airmail. All foreign subscriptions are payable in U.S. funds that can be drawn on a U.S. bank. Single copies \$3.50 in the U.S., \$4.50 in Canada. Executive, Editorial, Circulation, and Advertising Offices: One Phoenix Mill Lane, Peterborough, NH 03458. Second-class postage paid at Peterborough, NH, and additional mailing offices. Postage paid at Winnipeg, Manitoba, Canada Post International Publications Mail Product Sales Agreement No. 246492. Registered for GST as McGraw-Hill, Inc., GST #123075673. Printed in the United States of America. Postmaster: Send address changes and fulfillment questions to BYTE Subscriptions, P.O. Box 552, Hightstown, NJ 08520.

### PROCESSOR TRENDS

#### New 486 Chips Deliver Inexpensive Power.....30

The 486 might be reaching the end of its life, but it isn't dead yet. AMD has developed two new chips that shatter 486 speed barriers and offer Pentium-level performance at low-end prices. Meanwhile, Cyrix has developed an unusual new CPU that's a cross between a 486 and a 586-class chip.

### MULTIMEDIA

#### Interactive Music Videos Arrive for Macs and PCs...32

New interactive CDs, such as Todd Rundgren's "multimedia album" *The Individualist*, will bring the humble audio CD into the era of interactive content delivery using desktop multimedia systems.

### NEW PRODUCTS

#### What's New.....286

Dell's new Latitude XPi P90T notebook combines low-voltage Pentium power with impressive battery life. Plus, Micro Energetics' Nightware provides power management for printers; Horizons Technology's LANrecord meters software for NetWare LANs; and more.

## Opinions

#### Pournelle: Of COM Ports & Digital Frogs...275

BY JERRY POURNELLE

Jerry explores painless dissection with Digital Frog, then settles down for more bloodless surgery as he tries to make communications software work under Windows 95.

#### Books & CD-ROMs:

#### How to Optimize Your PowerPC Code.....33

BY TOM THOMPSON, ALAN JOCH, AND

RICH FRIEDMAN

Writing faster native code; plus, commerce on the Internet, and pool and nostalgia CD-ROMs.

#### Commentary: Dreaming of the Future ....330

BY DOUGLAS ENGELBART

Can digital technology make a better world? Improve our collective IQ? In the dreams of this visionary inventor it can.

#### Editorial BY RAPHAEL NEEDLEMAN.....10

#### Letters.....18

Readers' comments on the BYTE Network Project, Internet censorship, and the trouble with Microsoft.



This page presents the articles in this issue according to computing platform.

## **DOS/WINDOWS**

### **P6 Weakness Revealed .....24**

There's something weird about running 16-bit DOS and Windows applications on Intel's new-generation P6 CPU. The software would actually run faster on an old-time Pentium PC.

### **Delphi and VB Turn 32 .....26**

Upcoming versions of visual development tools from Borland and Microsoft will let you build 32-bit programs that take advantage of new features and interface elements in Windows 95. Another 32-bit bonus is NT compatibility.

### **New 486 Chips Deliver Inexpensive Power .....30**

You don't have to buy a Pentium to get better-than-486 performance. AMD and Cyrix have designed new high-speed CPUs that blow Intel's 486 out of the water. Systems based on these new chips promise to be inexpensive.

### **Interactive Music Videos Arrive for Macs and PCs.....32**

The new CD Plus format will bring multimedia music discs you can play in your PC.

### **Assets on the Line.....37**

Keeping track of all the hardware and software in an organization can be a full-time job. Vendors are designing products that can help.

### **Building Telephony Applications .....211**

New development tools, many of them based on Visual Basic, can help you construct a voice-processing system.

### **Telephony's Killer App.....215**

What's it going to take to make telephony a technology everybody's got to have? Some of these PC applications might do it.

### **The BYTE Network Project: Web Search .....223**

Windows NT tools help index the BYTE Web site.

### **Gateways to the Internet....229**

Which on-line service has the best Web browser—America Online, CompuServe, or Prodigy?

### **Presentation Quality.....233**

IBM's innovative display technology sharpens up the ThinkPad.

### **To Print a Rainbow .....239**

New color lasers from Apple and Tektronix give you better output, and they're easier to maintain than last year's sub-\$10,000 color lasers.

### **3-D Graphics Go Zoom .....243**

We review two different ways to get glorious graphics on a Windows machine. One's a complete system, one's an accelerator board.

### **Pournelle: Of COM Ports and Digital Frogs.....275**

Jerry goes to Microsoft for another Windows 95 dog and pony show. Back home, he uncovers more anomalies in the new operating system.

### **Preview: Impressive Battery Life in a Laptop Pentium PC .....286**

Dell's new Latitude line of lightweight computers—based on the new low-voltage Pentium—really knows how to wring the juice out of a battery.

## **OS/2**

### **Building Telephony Applications .....211**

Want to construct a voice-processing system? You don't have to abandon your favorite operating system to do it. Several telephony development tools run under OS/2.

### **Networking at Warp Speed .....235**

IBM has made its 32-bit operating system even more enticing by adding peer-to-peer networking, LAN requesters, and a ton of communications goodies. Plus, the new configuration process makes network installation a breeze.

### **Pournelle: Of COM Ports and Digital Frogs.....275**

Jerry checks out "nifty" Warp Connect and likes the way it handles multiple tasks and windows.

## **MACINTOSH**

### **Interactive Music Videos Arrive for Macs and PCs.....32**

New discs in the CD Plus format will mean you can play "multimedia albums" on your Macintosh. One of the first comes from longtime Mac user Todd Rundgren. His new CD will even let you play video director.

### **To Print a Rainbow .....239**

Tom Thompson reviews two new color laser printers: Apple's Color Laser

12/600 and Tektronix's Phaser 540. The output, he finds, could mean bad news for makers of dye-sublimation printers.

## **UNIX**

### **Building Telephony Applications .....211**

OmniVox (from Apex Voice Communications), Apprentice (from CTI Information Services), and IVS Builder/Server (from MediaSoft Telecom) are Unix-based tools for telephony.

### **Springtime at Sun.....271**

Wondering what future versions of the Solaris operating system will be like? SunSoft's new Spring, an OS equivalent of the "concept car," will give you some clues. Many of the features of Spring will eventually migrate to SunSoft's commercial system.

## **NETWORKS**

### **Assets on the Line.....37**

New products and collaborative efforts will help you keep track of your enterprise's hardware and software.

### **You Can Take It with You....41**

Accessing the corporate network from afar no longer requires magical incantations and good-luck charms. Here are some tips on picking the right mix of access technologies.

### **Standard Issue.....201**

Here's a guide to the various standards, APIs, technologies, and industry politics that you need to know about before you plug your phone system into your LAN.

### **Telephony's Killer App.....215**

A survey of the software that could make the integration of telephones and networks an essential business resource.

### **Networking at Warp Speed .....235**

IBM adds peer-to-peer capabilities to OS/2 and throws in a bunch of other goodies.

### **Lab Report: 16 Fast, Reliable RAID Subsystems .....248**

Looking for storage systems that cut down network downtime? This review will help you find the right stuff.

### **Tuning In to ISDN.....273**

ISDN Radio is cutting the copper umbilical cord and offering users real communications freedom.

<b>Asset management</b> .....	37
<b>ATM</b> .....	41
<b>Calculators</b> .....	25
<b>CD-ROM</b> .....	32, 275
<b>CPUs</b> .....	24, 30, 263
<b>Display technology</b> .....	233
<b>Education</b> .....	275
<b>Frame relay</b> .....	41
<b>Graphics</b> .....	239, 243
<b>Indexing</b> .....	223
<b>Internet</b> .....	223, 229
<b>ISDN</b> .....	41, 273
<b>Macintosh</b> .....	32, 239
<b>Multimedia</b> .....	32
<b>Networks</b> ....	37, 41, 235, 273
<b>Notebooks</b> .....	233, 286
<b>On-line services</b> .....	229
<b>Operating systems</b> ....	235, 263, 271, 275
<b>OS/2</b> .....	211, 235, 275
<b>P6</b> .....	24
<b>PowerPC</b> .....	263
<b>Printers</b> .....	239
<b>Programming</b> .....	33, 201, 211, 267
<b>RAID</b> .....	248
<b>Remote access</b> .....	41
<b>Security</b> .....	41
<b>Servers</b> .....	201, 248
<b>Storage</b> .....	248
<b>Telephony</b> .....	199, 201, 211, 215
<b>Unix</b> .....	211, 271
<b>Videoconferencing</b> .....	235
<b>Windows</b> .....	24, 201, 211, 215, 275
<b>Wireless</b> .....	273
<b>World Wide Web</b> .....	33, 223, 229



# BACKUP ON CD!



THE #1 SELLING RECORDABLE  
CD SYSTEM BY PINNACLE MICRO

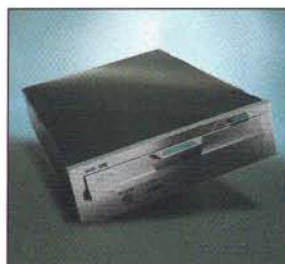
**\$1295\***

2 out of 3  
Recordable CD  
Systems sold today  
are Pinnacles!

## THE PINNACLE RCD-1000 IS 3 DRIVES IN 1!

1. **2X** Recordable CD System
2. Double-speed CD-ROM Player
3. Tape Backup Replacement

The RCD-1000™ is virtually 3 drives in 1 - making it the ultimate storage device for only \$1295. With the flexibility of Pinnacle's RCD-1000, the applications are endless. It's even plug-and-play compatible with Windows 95! As a **CD Recorder**, the RCD-1000 allows you to master your own CD that can be easily transported across town - or across the globe. As a **double-speed CD-ROM player**, it can read virtually thousands of educational, multimedia or audio CDs. And with Pinnacle's new **Backup Utility**, you can now replace your tape drive with a system that pro-



RCD-1000™ internal with  
SCSI controller & software  
**\$1295**



RCD-1000™ external with  
SCSI controller & software  
**\$1495**

Includes: Recordable CD software, valued at over \$500, as well as the new UP! Multimedia CD with 100 Startup Motivational Videos, a \$59.95 value, and 2 pieces of FREE Recordable CD media!

vides a more reliable solution and fast random access to your data for only \$19 per disc, or **3 cents** per megabyte. Each disc boasts 650 MB of data, audio, and video storage capacity.

The RCD-1000 is perfect for creating and mastering your own multimedia titles, interactive games, or even mixing your own audio CD of favorite tunes. You can back up accounting records, business plans, charts and graphs, or confidential information on CDs for decades - safe and secure. The RCD-1000 system is simply **the best** way to store, archive, distribute and create information. Best of all, it's now affordable - it's recordable!

\*PC internal version

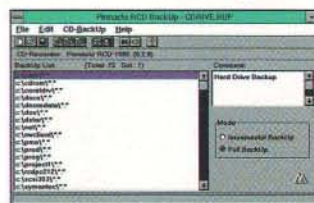
**TAPE IS OUT. OPTICAL IS IN.**



- Tape is slow
- No random access
- Five-year shelf life (Avg.)
- Too many different formats
- Reliable?



- Recordable CD is fast
- Random access
- One hundred-year shelf life
- CD-ROM standard format
- Very reliable



RCD Backup Utility



To order or for a  
dealer near you  
call: 800-553-7070



**PINNACLE MICRO**  
THE OPTICAL STORAGE COMPANY

Tel: 714-789-3000 Fax: 714-789-3150

Circle 81 on Inquiry Card (RESELLERS: 82).

All Trademarks and Registered Trademarks of Their Respective Owners.



# New Back-UPS:® \$119 blackouts, brownouts



Just don't have the time for power problems on your PC? Don't worry. They'll always make the time for you. It's not if a power problem will occur, but when. Due to household appliances, poor wiring, bad weather or even other office equipment, power problems are as inevitable as death and taxes. You can't run, but you can hide, behind APC protection.

That's why we've just introduced new models in our award-winning Back-UPS line, now delivering reliable protection for just \$119.

CAUSES OF COMPUTER DATA LOSS



Source: Contingency Planning

FREQUENCY OF POWER PROBLEMS



Source: Bell Laboratories

**IN THE NEXT THREE MONTHS, MORE THAN 30,000,000 PCs WILL BE HIT BY POWER PROBLEMS...**

Who needs power protection? If you use a computer, you do. A study in a recent *PCWeek* showed that the largest single cause of data loss is bad power, accounting for almost as much data loss as all other causes combined. Every PC plugged into an outlet is vulnerable. In fact, you have better odds of winning the lottery than of escaping the sting of power problems. One study found a typical PC is hit over 100 times a month, causing keyboard lockups, hard drive damage, and worse.

Simply put, if power problems are the least of your troubles, you've got one chance to keep it that way. You insure your car and home with the best policy you can afford. It just doesn't make sense to leave your PC (which is at far greater statistical risk) vulnerable to loss or damage.

**WHY A \$119 APC UPS COSTS LESS THAN A \$9. "SURGE PROTECTOR"...**

Contrary to most people's belief, a PC alone already has more protection built into it than a low-end "surge suppressor," which is usually nothing more than a well-packaged extension cord. In other words, going without any protection is just as good as underspending on one of the most important PC decisions you'll make.

And since sags and blackouts represent more than 90% of power problems likely to hit your computer, even quality, high-performance surge suppressors are literally powerless to protect you from data loss.

That's why you need instantaneous battery backup power from an APC Uninterruptible Power Supply to prevent



**For extended brownout protection for advanced PC workstations call about APC's New Back-UPS Pro!**

**PC World  
Top 20  
Upgrade**

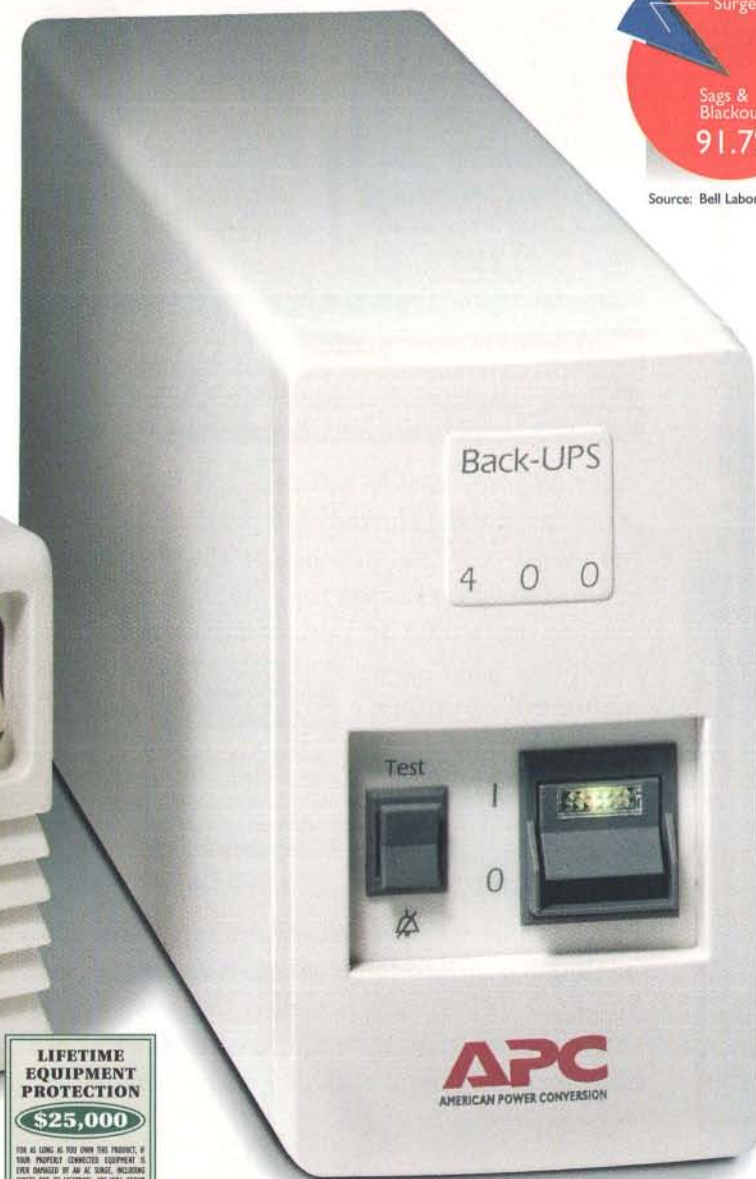
*"Don't take chances. Get the ultimate protection... from APC."*  
--PCWorld

*"★★★★★ Back-UPS should be standard on every desktop... effective, affordable, designed to last..."*  
--PC Computing

*"A UPS can pay for itself the first time it saves your data."*  
--MacUser



*"The clear winner in price performance... it's unbeatable..."*  
--PC Magazine UK





# protection against and other trials by fire

More than 3,000,000 satisfied customers count on APC reliability that goes above and beyond the call of duty

After a raging fire which took 18 trucks to subdue, Michael Benolkin, director of the Systems Division at Correa Enterprises, Inc. didn't expect much. "While rummaging through the ashes, we heard something beeping. Our four APC units were still in action, while two UPSes from another brand were history. We're still using these same APC units at our new office location - they still work like a charm! We're impressed with the ruggedness, reliability, and product support offered by APC."



**Trial by Fire**

Brian Krause, Network Manager for Goodyear Airship Operations, knows how critical APC protection can be. "The night of the All-star game a tornado came through our blimp hanger and took out our roof. Our airships demand absolute communication so I protect our local and remote servers with the most reliable protection I can find: APC. APC's PowerChute software shut our server down in an orderly way... closed out all files nice and neatly. When we reconnected, everything came back up perfectly, without a hitch."



**Trial by Air**

Doug Welch learns his reliability lessons well: "While still a Computer Science student, I was at home preparing a large spreadsheet for a final project when Anchorage experienced an all too common 5+ Richter earthquake. If not for my Back-UPS 400 it would have been back to square one! I'm now the Network Systems Manager at Charter College, in charge of three networks. I learned my UPS lesson well back in my student days. I've never been disappointed with APC and the product has had quite a work out."



**Trial by Earth**

Faced with a water main break, Mark Conley, Regional Manager of Novell's remote sales office in Detroit was amazed at APC's reliability. "The APC unit was sitting in an inch and a half of water, working just fine, as though nothing was unusual and we lost no data to this disaster. We've used APC here now for at least four years - more than a dozen units are all around the office, and we're well satisfied, so we were even more impressed to learn that the units are amphibious!"



**Trial by Water**



## Back-UPS Award Winning FEATURES

- ▶ Unmatched surge/lightning protection for maximum hardware safety
- ▶ Site diagnostics automatically spot missing ground and reversed polarity
- ▶ LAN signaling allows simple shutdown with interface kits for automatic data protection (400 and above)
- ▶ User replaceable, hot swappable batteries insure uptime safe disposal. Batteries will last 3-5 years under normal use.
- ▶ \$25,000 lifetime Equipment Protection
- ▶ 10 minute runtime with specified applications. For longer runtimes choose next largest unit.

Model	Application	Sugg. List
200 <b>NEW</b>	"Green" PCs	\$119
280 <b>NEW</b>	LAN Nodes	\$139
400	Desktop 486/386 systems	\$199
450	Tower 486/386 systems	\$254
600	CAD/CAM workstations	\$359
900	Longer runtime	\$529
1250	Multiple systems	\$689

keyboard lockups, data loss, and crashes. With an APC UPS, you get six times the protection of a high-end surge protector for little more than twice the price. And \$119 is much less expensive than false peace of mind. APC UPSs carry up to a \$25,000 lifetime guarantee against surge damage to your properly connected equipment, and are available to suit any application, from network servers and PCs, to fax and satellite systems.

## PROTECT YOURSELF OR KICK YOURSELF...

It's been said that there are two types of computer users: those who have lost data, and those who are about to. Prevent the single largest cause of computer problems and join a fast-growing third category: those who protect their PC's with the most reliable protection they can buy: APC UPSes. So ask for APC at your favorite reseller. At just \$119 an APC UPS is serious protection no serious computer user should be without.



Visit APC's  
**NEW**  
PowerPage<sup>®</sup> on  
the Internet

[www.apcc.com](http://www.apcc.com)

APC has won more awards for reliability  
than all other UPS vendors combined...



# APC<sup>®</sup>

AMERICAN POWER CONVERSION

**Call 800-800-4APC**

Tel: (401)789-5735

Fax: (401)788-2797

Compuserve: GO APCSUPPORT

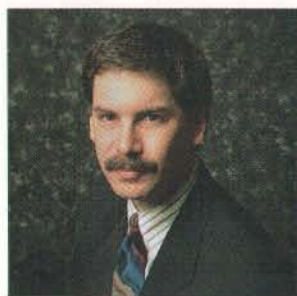
Internet: [apctech@apcc.com](mailto:apctech@apcc.com)

please reference Dept. A2





# Old Enough to Know Better



**You'd think that after 20 years of writing about computers, we'd have learned a thing or two**

With this issue, BYTE celebrates its twentieth anniversary. Like most of you, we've been studying the microcomputer business for a long time. I like to think that in 20 years we've learned a lot—not just about computers and the computer market, but about how new markets grow. And most important, how events in the various technology markets can be used as lessons for other industries.

*Computers don't cost jobs.* If you look at specific markets or companies (say, for example, Smith Corona's typewriter business), you will of course see the elimination of jobs and even entire markets. But the computer industry as a whole is growing rapidly and is a key engine behind job growth in several service industries, such as banking and medicine.

Thanks to advancing technology, many industries are changing more quickly than they ever have. With change comes disruption, competition, and the decline of companies and people who don't track the change. But change also carries opportunity and growth for those who can adapt to it.

*Preemptive marketing works.* Just ask Adam Osborne, who preannounced his Osborne Model II portable computer while still sitting on a warehouse of Model I's. Anticipation of the Model II killed what was left of the Model I's sales. In the process, it killed Osborne Computer itself. Of course, giving the market a whiff of vapor can work to your great advantage—witness the hypefest that preceded the Windows 95 launch. Auto manufacturers have been preannouncing products and vague "concept cars" for years. Sure, it's slimy. And it can bite you if you manage it wrong. But that's the way marketing works today.

*Technology doesn't always fix problems.* Boys will have their toys, but sometimes they have been known to get carried away. Witness Denver International Airport, which is otherwise known as the world's largest bug. The problem: Airline baggage handling is slow, expensive, and error-prone. Denver's solution: A computer-

ized baggage system that avoids the evidence of mis-routed luggage by ripping it to shreds. Hint: If the process is fouled up, a computer won't fix it—it will just automate the problems.

*The paperless office?* Yeah, right. Paper grows on trees—and also in your office. There's a tale that when NASA used to receive satellites from the manufacturer, they came on two trucks: one for the space vehicle and one for the documentation. Now, we have made great strides in indexing and document retrieval in the last 20 years, but people still want their books—and their magazines, thank goodness. Electronic distribution is an additional channel for information, but it cannot replace all other media.

*There's always one more bug.* There is no such thing as a bug-free computer product. It's the unfortunate nature of the beast. Therefore, if you're going to release a product into the market, you should know ahead of time what you will do if the worst happens. Of course, this applies to all industries, not just technology. Intel didn't realize this until too late, and confidence in its Pentium took a serious dive for a long while. But when Intuit found out about the bug in its TurboTax program, it followed the L.L. Bean model: The company took the product back and fixed it. People still trust Intuit. Be honest with your customers.

*Support your customer.* Thanks in no small measure to the golden era of free telephone support for computer products (now gone, alas), a whole generation of consumers now expects companies to offer telephone help-desk support. From refrigerators to mutual funds, if a product can possibly confuse somebody, it will. But if confused customers can call you, in their darkest hour of need, and you can rescue them, you'll have built a stronger relationship—and improved your chances for future business.

*It's a Webbed world.* You say you can't possibly think of another feature to add to your widget? Put Web functionality in it. Everybody else is, after all. Warning: This may not work for the home appliance industry. But then, you never know. ■

A stylized, handwritten signature of Raphael Needleman.

RAPHAEL NEEDLEMAN, EDITOR IN CHIEF  
(rafe@well.com)



50% BRIGHTER. 25% SMALLER.  
*It's not just active matrix.*  
**IT'S HYPER**  
*active-matrix.*



Hyper. It means above and beyond. And that's our new LitePro 580.

It's the smallest, lightest and brightest multimedia projector. Ever.

The LitePro 580 has built-in video support and stereo speakers. Yet it's about the size of an ordinary slide projector. It's packed with other features, too, like a zoom lens that will fill a 7 meter wall with your image. And a remote control with trackball that operates your PC or Mac like a wireless mouse.

Plus, it's got the latest polysilicon active matrix

LCD. So, together with advanced dichroic optics, it gives you the brightest image (well over 200 lumens reflected off the screen) and the truest, most saturated colours of any LCD projector.

And that means you can deliver outstanding full-motion multimedia presentations and training sessions without having to dim the lights.

As the leader in LCD projection, we offer a complete line of projectors and panels for any need and budget. Including the new standard – the LitePro 580. Compared to anything else out there, it's hyper.



New polysilicon active matrix means you get the highest image quality of any LCD projector.



**InFocus®**  
SYSTEMS  
Great ideas. Brought to light.™

*Discover electronic presentations. For a test drive or free demo disk call*

UK: 0500 262 440 Germany: 0130 813 649 France: 0590 5993 Italy: 1678 77238 Spain: 900 993 163



# E-MAIL FOR PEOPLE THINGS TO DO, PLACES AND PEOPLE



*Schedule+'s alarm clock  
reminds you of meetings,  
deadlines, anything.  
So you'll stay organized  
and save time. And never  
miss another meeting.*



In other words, people like you. People who need more time. And fewer headaches. Microsoft® Mail lets you do more, while keeping you connected, whether you're down the hall or down under on business. No wonder Microsoft Mail is the best-selling LAN-based mail product in the world.

For a start, Microsoft Mail works perfectly with what you already have. Whether you're in Windows® 95, Windows NT,™ MS-DOS®, on a Mac®, or OS/2®. And you can send mail without exiting the applications you're working in. And send faxes right from your word processor. Whether you're in Microsoft Word, Microsoft Excel, Lotus® 1-2-3® or WordPerfect®.



# WITH

# TO GO LE TO SEE.



*With Mail Remote,  
you don't need to be in  
your office to keep in touch.  
And with wireless service,  
you don't even need  
to be near a phone.  
You can log in anywhere.*

How can Microsoft Mail save you time? Mail has smart, sensible symbols and online help that make learning to send and receive mail easy. Even messages that include graphs, pictures and sound. You can save even more time by adding features that are just as easy to use as Mail. Like Schedule+, the best-selling scheduler for Windows. It helps you manage your calendar and reminds you of meetings and deadlines. It even shows you when everyone is free. So you can schedule meetings without a lot of legwork. Microsoft electronic forms let you speed expense reports, vacation requests and other important forms through your office at the speed of light. And with electronic forms you can track them easily.

Finally, with Mail Remote you can stay connected and work just like you do in your office when you're on the road. Not only that, it can also save you money. Just read the important messages, then let Mail Remote respond automatically when transmission rates are lowest.

No other mail system is easier to use or easier for your IS people to administer. Or engineered like Microsoft Mail to take advantage of new information exchange technologies. To find out more, just add one more thing to your to-do list: Call (800) 871-3271, Dept. AV3, and ask for our free Microsoft Mail information kit.



HIGHLY INTEGRATED WITH  
MICROSOFT OFFICE

EASY TO ADD FAX AND  
INTERNET CONNECTIVITY

EASY TO INSTALL AND  
EASY TO ADMINISTER



## Microsoft

WHERE DO YOU WANT TO GO TODAY?™



**EDITOR IN CHIEF**  
Raphael Needleman

*Editor in Chief's Assistant:* Linda Higgins

**EXECUTIVE EDITORS**  
Rich Friedman, Jon Udell

**MANAGING EDITOR**  
Lauren Stickler Thompson

**NEWS**  
**Peterborough:**  
News Editors: David L. Andrews,  
Martha Hicks  
**New York:**  
News Editor: Salvatore Salamone

**San Mateo/West Coast:**  
Senior Editor: Tom Halfhill  
**Frankfurt:**  
Senior Editor: Rainer Mauth

**PRODUCT REVIEWS**  
Director: Stanford Diehl  
Senior Technical Editors: Rick Grehan,  
Douglas Tamasanis  
Technical Editors: Rex Baldazo,  
Susan Colwell, David Essex,  
Dave Rowell  
Reviews Assistant: Lisa O'Neill

**STATE OF THE ART/FEATURES**  
**San Mateo:**  
Features Editor: John Montgomery  
**Peterborough:**  
Senior Editor: Alan Joch  
Technical Editor: Russell Kay  
**Lexington:**  
Senior Editor: Edmund X. DeJesus

**SENIOR TECHNICAL EDITOR**  
At Large: Tom Thompson

**SENIOR RESEARCHER**  
Rowland Aertker

**ASSOCIATE TECHNICAL EDITORS**  
Dennis Barker, Cathy Kingery,  
Mark Reynolds, Warren Williamson

**SENIOR CONTRIBUTING EDITOR**  
Jerry Pournelle

**CONTRIBUTING EDITORS**  
Stephen Apik, Dick Pountain

**CONSULTING EDITORS**  
Nicholas Baran, Raymond GA Côté,  
Trevor Marshall, Stan Miaszkowski,  
Barry Nance, Roberta Pournelle,  
Ellen Ullman, Peter Wyner

**EDITORIAL ASSISTANTS**  
Tammy Grenier, June Sheldon

**DESIGN**  
Design Director: Charles Dixon III  
Associate Design Director/Design &  
Photography: Sharon Price  
Associate Design Director/Graphics:  
Joseph A. Gallagher  
Production Manager: David R. Anderson  
Desktop Prepress Manager:  
Virginia Reardon  
Designers: Barbara Busenbark, Jan Muller,  
Donna Sweeney  
Design Assistant: Cindy Sands

**EDITORIAL INTERN**  
Jeff MacClay

## **BIX Interactive On-line Service**

**MANAGING EDITOR**  
Christine Taylor

**EXCHANGE EDITORS**  
Amiga Exchange: Joanne Dow  
Entertainment and Leisure Exchange:  
Rich Taylor  
IBM Exchange: Barry Nance  
Programmers Exchange: Bill Nicholls  
Professionals Exchange: David Reed  
Toljery Exchange: Jerry Pournelle  
WIX Exchange: Karen Kenworthy  
Writers Exchange: Wayne Rash Jr.

**20TH ANNIVERSARY SECTION**  
**CONTRIBUTORS**  
Art Director: Brian Day, Fisher & Day  
Copy Editor: Ellen Bingham  
Best Books & CDs Photography:  
Dennis Bettencourt Photography  
Page Headers, Digital Imaging,  
and Manipulation: John Lund Studios  
Staff Photograph: Britain Hill

**FINANCE AND OPERATIONS**  
Director: Claudia Flowers

**ADVERTISING PRODUCTION**  
Advertising Production Manager:  
Linda Fluhr  
Senior Advertising Services  
Representative: Lyda Clark  
Advertising Services Representatives:  
Dale J. Christensen, Karen Cilley,  
Rod Holden  
Operations Assistant: Lisa Jo Steiner  
Advertising Graphics Manager:  
Susan Kingsbury  
Graphics Production Coordinator:  
Christa Patterson

**FINANCE**  
Senior Financial Analyst: Kathleen DeGuise  
Systems Administrator: Peggy Dunham  
Junior Financial Analyst: Diane Henry  
Production Assistant/Purchaser:  
Agnes Perty

**MARKETING AND PLANNING**  
Director: L. Bradley Browne  
Administrative Assistant: Arja Neukam  
Marketing Communications Manager:  
Rob Mitchell  
Marketing Art Director:  
Stephanie Wamesky  
Market Research Manager: William Zhao  
Copyrights Manager: Faith Kluntz  
Assistant Manager, Marketing Events:  
Carol Sanchioni  
Marketing Services Administrator:  
Meredith Bickford

**CIRCULATION**  
Circulation Manager: Paul Ruess  
International Circulation Manager:  
Barbara Copcutt  
Subscriptions Manager:  
Lynn Lagasse  
Subscription Source Specialist:  
Christine Tourgee  
Newsstand Manager: Vicki Weston  
Assistant Manager: Karen Desroches  
Back Issues: Jill Wood  
Direct Accounts Coordinator: Ellen Dunbar

**TECHNICAL ASSOCIATE**  
Mark Lavi

BIX, owned and operated by Delphi Internet Services Corporation, is a worldwide, low-cost, on-line information service featuring industry news, downloadable software, powerful electronic mail, previews of upcoming BYTE articles, the full text of published issues of BYTE, and source and/or executable code for BYTE benchmarks and noncommercial software mentioned in feature articles. BIX also offers unmatched "conferences" on virtually every computer-related topic imaginable, where you can share information with thousands of other computer pros. To subscribe via modem, set your communications software to full duplex, 7 bits, even parity, 1 stop bit, and then call (800) 695-4882 or (617) 491-5410, or telnet to x25.bix.com and type "bix" at the USERNAME prompt. At the Name? prompt, type bix.ville. For more information, call (800) 695-4775 or (617) 354-4137 (voice); send a fax to (617) 491-6642; or send Internet mail to info@bix.com.

**PUBLISHER**  
David B. Egan

*Publisher's Assistant:* Donna Nordlund

**ADVERTISING SALES**  
VP/Sales:  
John M. Griffin (212) 512-2367  
Peterborough, NH (603) 924-2663  
Administrative Assistant:  
Terry Ouellette (603) 924-2635

**NEW ENGLAND**  
Sanford L. Fibish (617) 860-6344  
Merle Model (617) 860-6221

**MID-ATLANTIC**  
Michael Feinberg (212) 512-4811  
Susan Rastellini (617) 860-6265

**SOUTHEAST**  
Mary Ann Goulding (404) 843-4782  
Margot Swanson (603) 924-2651

**MIDWEST**  
Jennifer Walker (614) 899-4908  
Ed Ware (603) 924-2664

**SOUTHWEST, ROCKY MOUNTAIN**  
Jennifer Walker (214) 701-8496  
Kevin Lary (603) 924-2527

**SOUTH PACIFIC**  
Beth Dudas (714) 753-8140  
Mark Speros (714) 753-8140  
Brad Dixon (603) 924-2574

**NORTH PACIFIC**  
Roy J. Kops (415) 513-6861  
James Bail (603) 924-2662

**INSIDE ADVERTISING SALES**  
Director of Sales Operations:  
Diane Lieberman  
Assistants: Susan Monkton, Vivian Bernier

**THE BUYER'S MART (1 x 2) and**  
**HARDWARE/SOFTWARE SHOWCASE**  
Ellen Perham (603) 924-2598  
Mark Stone (603) 924-2695

**REGIONAL**  
Brian Higgins (603) 924-2596

**BYTE DECK**  
Brian Higgins (603) 924-2596

**EURO-DECK**  
Joseph Mabe (603) 924-2533

**INTERNATIONAL ADVERTISING SALES STAFF**  
See listing on page 325.

**PERSONNEL**  
Human Resources Administrator:  
Patricia Burke  
Assistant: Fran Wozniak  
Receptionist: Beverly Goss

## **How to Contact the Editors**

We welcome your questions, comments, complaints, kudos, and submissions.

**MAIN OFFICE:** One Phoenix Mill Lane, Peterborough, NH 03458, (603) 924-9281.

**San Mateo:** 1900 O'Farrell St. #200, San Mateo, CA 94403, (415) 513-6912.

**New York:** 1221 Avenue of the Americas, New York, NY 10020, (212) 512-3588.

**Lexington:** 24 Hartwell Ave., Lexington, MA 02173, (617) 863-5100.

**GERMANY/EUROPE:** Liebigstrasse No. 19, 60323 Frankfurt, Germany, +49 69 7140 7123.

**ELECTRONIC MAIL:** On BIX, send to "editors." All BYTE editors and columnists also have individual mailboxes on BIX for easy access.

**MCI:** 250-0135 BYTE Magazine. Many editors also have individual MCI addresses in their own name.

**OTHERS:** Many editors also are reachable through unet, AppleLink, CompuServe, and numerous other services.

**WEB:** http://www.byte.com

**U.S. fax:** Editorial: (603) 924-2550

**Advertising:** (603) 924-7507

**U.K. fax:** +44 171 495 6734

**SUBMISSIONS:**

**Authors:** We welcome article proposals and submissions. Unacceptable manuscripts will be returned if accompanied by sufficient return postage. Not responsible for lost manuscripts or photos.

**Vendors:** We welcome news of your new products; please call the News department or the BYTE Lab at the earliest possible date. We cannot be responsible for unsolicited product samples.

**ARTICLE REPRINTS:** For price quotations on customized reprints of BYTE articles, contact Susan Monkton, reprints manager, at (603) 924-2618. (Minimum quantity: 500.)

## **Subscription Customer Service**

**Inside U.S. (800) 232-BYTE;** outside U.S. +609 426 7676. E-mail: mpcstsv@mcgraw-hill.com. Web: http://www.mcgraw-hill.com/multipub.

International subscribers may also contact our international customer service facility in Galway, Ireland, by calling +353 91 752792 or via fax: +353 91 752 793.

**For a new subscription, (800) 257-9402** U.S. only. E-mail: mporders@mcgraw-hill.com or write to BYTE Subscription Dept., P.O. Box 555, Hightstown, NJ 08520. Subscriptions are \$29.95 for one year, \$54.95 for two years, and \$74.95 for three years in the U.S. and its possessions. In Canada and Mexico, \$34.95 for one year, \$64.95 for two years, \$87.95 for three years. In Europe, £42 (US\$60) for fast surface delivery, £55 (US\$80) for air delivery. Non-European countries US\$60 for surface mail, or US\$85 for air mail. Single copy price is \$3.95 in the U.S. and its possessions, \$4.95 in Canada. Foreign subscriptions and sales should be remitted in U.S. funds drawn on a U.S. bank. Please allow six to eight weeks for delivery of first issue.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

**PHOTOCOPY PERMISSION:**

Where necessary, permission is granted by the copyright owner for those registered with the Copyright Clearance Center (CCC), 222 Rosewood Dr., Danvers, MA 01923, to photocopy any article herein for personal or internal reference use only for the flat fee of \$1.50 per copy of the article or any part thereof. Correspondence and payment should be sent directly to the CCC, 222 Rosewood Dr., Danvers, MA 01923. Specify ISSN 0360-5280, \$1.50. Copying done for other than personal or internal reference use without the permission of The McGraw-Hill Companies, Inc., is prohibited. Requests for special permission or bulk orders should be addressed to Faith Kluntz, copyrights manager, (603) 924-2525. BYTE is available in microform from University Microfilms International, 300 North Zeeb Rd., Dept. PR, Ann Arbor, MI 48106 or 18 Bedford Row, Dept. PR, London, WC1R 4EJ, U.K.

## **OFFICERS OF THE MCGRAW-HILL COMPANIES, INC.**

**Chairman and Chief Executive Officer:** Joseph L. Dionne; **President and Chief Operating Officer:** Harold W. McGraw III; **Senior Executive Vice President, and Secretary:** Robert N. Landes; **Senior Vice President and General Counsel:** Kenneth M. Vittor; **Executive Vice President and Chief Financial Officer:** Robert J. Bahash; **Senior Vice President, Treasury Operations:** Frank D. Penglase; **President, Information Services Group:** Michael K. Hehir; **Executive Vice President, Publication Services:** Norbert Schumacher.

**Founder:** James H. McGraw (1860-1948).



# Our Integration Software Shares Files On Any Platform You Use.

## Well, Almost.

### Four Great Products For Simple File And Disk Sharing Across Multiple Platforms.

Intergraph's full line of Windows NT and UNIX integration products makes it easy to cross platforms. Streamline client/server networks. And simplify every system manager's life.

#### **PC-NFS for Windows NT.**

Lets Windows NT users access files and resources on UNIX servers and workstations. And connect to corporate databases and mail systems. From the familiar Windows interface.

#### **DiskShare for Windows**

**NT.** Lets UNIX NFS users access files and directories on Windows NT servers and work-

stations. While taking advantage of UNIX utilities to manage files on Windows NT seats. With Windows point-and-click interface.

#### **eXalt for Windows NT.**

Lets eXalt users move quickly between X-based applications and Windows NT. Without cumbersome text-file editing. Using a Microsoft Windows, Open Look, OSF/Motif or twm look-and-feel.

**Batch Services for Windows NT.** Lets Windows NT users schedule, manage and reschedule non-interactive jobs. Locally or network-wide. With the Windows interface.

#### **Total Support. 100% Satisfaction Guaranteed.**

Like all Intergraph software, these integration applications come with the industry's top-ranked support. And a 30-day, 100% satisfaction guarantee.

For more information call:

U.S.	800-345-4856
Asia-Pacific	852-893-3621
Canada	800-461-5297
Europe	31-2503-66333
Middle East	971-4-367555
Other areas	1-205-730-5499

Internet: <http://www.intergraph.com>

"If you need to share files between Windows NT and UNIX or another NFS system, these excellent products will do the job with a minimum of fuss."

*Open Systems Today 11/28/94*

## INTERGRAPH®

SOFTWARE SOLUTIONS

SunSelect, the Sun logo, NFS and ONC are trademarks or registered trademarks of Sun Microsystems, Inc. Intergraph and the Intergraph logo are registered trademarks of Intergraph Corporation. Microsoft is a registered trademark and Windows, Windows NT, Windows 95, and the Windows logo are trademarks of Microsoft Corporation. Other brands and product names are trademarks of their respective owners. ©1995 Intergraph Corporation, Huntsville, AL 35894-0001.

Circle 518 on Inquiry Card (RESELLERS: 519).





**Olivetti ink-jet printers.**

# Before choosing any other printer, count to ten.



## **1 The best of Olivetti's know-how.**

Olivetti is Europe's biggest manufacturer of ink-jet printers. Its products are the result of 20 years' experience and research in this sector and all of Olivetti's plants and production processes have received ISO 9001 total-quality certification.

## **2 JP 450: productivity and flexibility.**

The JP 450 is the fastest printer of its kind. It prints up to 5 pages a

minute and can reach a virtual resolution of 600 x 300 dpi in text mode - perfect print quality. Silent and powerful, it can be equipped with numerous options such as a 2nd sheet-feeder, a sprocket for continuous stationery or a special feeder for envelopes and transparencies, making it a highly flexible tool even for automatic mailing. And the JP 450 is already preset to give you excellent colour prints.

## **3 JP 360: the best at a low price.**

Also preset for colour printing, the

JP 360 offers the best price/performance ratio. In fact, it gives you the same print quality as the JP 450 - both in black and white and in colour - using the same print heads. It can print up to 3 pages a minute and takes up a minimum of space.



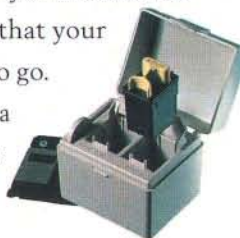


## 4 The best colour when you need it.

The optional colour kit for the JP 450 and JP 360 opens the door to high-quality printing.

You decide when you want to use colour, knowing that your printer is ready to go.

The kit contains a manual with lots of tips on creating the best colour documents, plus the powerful Olichrome driver for hi-fi chromatics.



## 5 JP 50: portable technology.

The JP 50 concentrates desktop performance into 1100 g. and 30x13x6 cm. It works when and where you want it to, running either off the mains via the standard power adapter (which doubles as a battery charger), on regular or optional rechargeable batteries -



providing 80 to 140 page autonomy - or on the optional car adapter cable. Although it's the smallest and lightest portable ink-jet printer, the JP 50 offers 300 dpi resolution, prints 1.7 pages a minute and has a built-in ASF.

## 6 Low running cost.

All of Olivetti's ink-jet printers use a patented refill system that allows a significant cost per page reduction compared with traditional ink-jet printers. The actual print head can be reused several times - only the ink cartridge is changed. All models automatically signal when the refill is running out so that the head doesn't run dry, protecting it from possible damage. They also give you economy or draft print choices that save about 50% on ink. All this at energy consumption 20 times lower than a laser.



## 7 Fonts for free expression.

Olivetti ink-jet printers give you the utmost freedom of expression, thanks to their wide range of fonts - 30 resident and 25 scalable True Type fonts for Windows.



## 8 Total compatibility.

Every feature of the Olivetti ink-jet printers, even the most exclusive, is immediately available thanks to a range of drivers loaded on the disk that comes with the printer. Designed and certified by Olivetti, the drivers are tested and approved by the biggest international software producers to guarantee their full compatibility and optimum performance. In the package you'll find drivers for Windows and the most popular DOS programs, while those for

Technical Features			
	JP 450	JP 360	JP 50
Ink-jet Refilling System	Yes	Yes	Yes
Color Kit	Yes	Yes	-
Max resolution (dpi)	600x300	300	300
Max speed (cps)	400	180	100
ASF capacity	150	70	15
cps in LQ mode	160	120	100
TrueType scalable fonts	25	25	25
Resident fonts	30	30	30
Page per min. (max)	5	3	1.7
Expansion slot	1	1	-

more specific needs (such as Windows NT and OS/2) are available on request.

## 9 Ergonomic design.

In the Olivetti tradition, design is always in the forefront. The softly rounded, exclusive and attractive shapes of these printers are the result of rigorous, ergonomic research to guarantee their easy, safe and dependable use.

## 10 Customer care: 15,000 specialists.

Those selecting Olivetti JP printers find an international network of 5,500 Dealers and Systems Partners and 15,000 specialists to provide companies with all of the assistance, support and advice they need. This, like the others listed above, is only one of the many reasons for relying on Olivetti. And for counting to ten before choosing any other printer.

For further information, phone :

Austria (1) 816940 - Belgium (2) 2299111  
Denmark (31) 201000 - Finland (0) 88741  
France (1) 49067000  
Germany (69) 66922755  
Greece (1) 9373800 - Holland (71) 319931  
Israel (3) 7516879 - Italy (167) 012587  
Norway (22) 186100 - Portugal (1) 3558260  
Spain (900) 370370 - Sweden (8) 59005200  
Switzerland (1) 8391565  
Turkey (212) 2750810 - U.K. (800) 447799.

# olivetti



## The BYTE Network Project

I enjoyed Jon Udell's article on establishing a World Wide Web site ("Hello, World," July), especially the sidebar titled "Don't Dis the Host." I, too, use and prefer text-based Internet access. Udell called himself a "knuckle-scraping Neanderthal" for preferring text browsers. Thanks for affirming that there are still some fellow Paleolithic types out on the Internet.

Erik Farquhar  
farquhar@acsu.buffalo.edu

Nice to see you guys on the Web. I noticed at the end of your "Hello, World" piece that you mentioned eventually trying out OS/2 and Unix servers. I would find a comparison of Mac vs. other operating systems useful. The freeware MacHTTPd and its commercial incarnation, WebStar from StarNine, are the obvious choices, and Apple offers bundles with all the necessary Internet server software. If you are going to give the other platforms a shot, don't pass over the Mac.

Mark Eaton  
marke@nwlinc.com

*Point taken. I tend not to think of the Mac as a heavy-duty server platform since the OS still lacks robust memory protection and preemptive multitasking. But serving up HTML documents, at least on a modestly trafficked Web site, need not be a particularly demanding server application. Thanks for the reminder.—Jon Udell*

I was told that the BYTE Web site would be operational within a couple weeks. Is it ready yet?

Gene Belanger  
Houston, TX

*Yes, our Web site is up and running, and it provides a link to our FTP server from which you may download BYTE's benchmark source code and executables. Our URL is <http://www.byte.com/>.—Eds.*

## MacThanks

I just wanted to thank you for Tom Thompson's expertly written and in-depth article about Apple's upcoming Copland

operating system ("Apple's New Operating System," June). Your articles about Macintosh technology have always been excellent, and I look forward to reading them. See if you can sneak some more in.

In a world holding its collective breath for Windows 95 (or 96), it was refreshing to read about the state of the next MacOS.

Christopher Gervais  
cgervais@eworld.com

## Free the Net

I was much interested in Arun Mehta's Commentary on "freedom" of the Internet ("Radio Free Usenet," July). My daughter is in Croatia, my sister is in Tennessee, and I am in Atlanta, and we all communicate through E-mail transmitted via the Internet. And now I can send messages to Mr. Mehta in India. He was correct that the old U.S.S.R. had to choose between the benefits of PC technology and the risk of losing control over information. The world is racing ahead toward a global system, and yet some people are still in the dark ages.

Shelia Perkins  
Atlanta, GA

I agree wholeheartedly with Mr. Mehta's assessment of the Usenet system. I am particularly concerned about the threat posed to Usenet by the ignorant and misguided efforts of some members of the U.S. legislative bodies.

Richie Trenthem  
Memphis, TN  
trenthem@rhodes.edu

I want to thank Arun Mehta for his Commentary. I share his concerns about the Exon amendment in particular and Net censorship in general.

Dave Parker  
diparker@dlpinc00.com

*Eighty-six U.S. Senators voted to approve a legislative measure that could make people liable for statements they make in E-mail messages that would be protected in a conventional letter. Senator Hatch (R-Utah) characterized the proceedings as "a game, to see who can be the most against pornography and obscenity. It's a political exercise."*

—Arun Mehta

## Tsunami Benchmarks

Your news story about the Power Macintosh 9500 ("Apple's Tsunami: PCI Power," July) includes a table of benchmark results. The floating-point results for a Power Mac 8100/100 are just one-third (.375) as fast as the 90-MHz Pentium baseline. If this were really true, I'm sure Intel would not have downplayed the Pentium's floating-point performance.

Steve Willie  
sfw@mcs.com

*The Power Mac 8100/100 used an older floating-point library that was much less optimized than the library shipping with the Power Mac 9500. An update to System 7.5 provides this new library to existing 601-based Power Macs.*

—Tom Thompson

## Not Building for Windows 95

I read your sidebar about Microsoft's Windows 95 Migration Planning Kit ("How Best to Migrate to Windows 95," July). Any search tool that requires you to already have Excel, Word, and Power Point installed will be "cluttered and counterintuitive." And I think you were too easy on Microsoft when you called their Windows 95 payback spreadsheet "an incomplete business-analysis tool." It's not incomplete, it's totally useless. I'll stick to Windows 3.11 while this first wave of Windows 95 drowns all the early adopters.

George Morgan  
Syracuse, NY

Hey, I think you guys down at BYTE are a little biased toward Windows. You praise Windows 95 when it had not even been delivered. Don't talk about how good it is and just totally ignore a real 32-bit operating system like OS/2.

Michael Bernstein  
Rockford, IL  
insanity@rockford.com

*We don't ignore OS/2. See this month's review of Warp Connect ("Networking at Warp Speed," page 235).—Eds.*

**We want to hear from you.** Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458; or you can send E-mail via the Internet or BIX to editors@bix.com. Letters may be edited.



# Exabyte's new 8mm XL tape drive is the perfect union of capacity and reliability.

- ▶ 14 GB capacity compressed
- ▶ 1 MB/second transfer rate compressed
- ▶ 160,000 hours MTBF
- ▶ Extended-length media
- ▶ Half-high form factor
- ▶ Backward compatible

EXABYTE IS  
EVERYWHERE

8mm

4mm

Quarter-Inch

Libraries

Media

Accommodating the new eXtended Length data-grade 8mm media, the EXB-8505XL 8mm tape drive can store 14 gigabytes of compressed data per cartridge. That's nearly two times the capacity of DDS-2 drives. Using the EXATAPE™ 160XL data cartridge with its Recognition System assures users of the highest data reliability and integrity. And this new high-capacity tape drive can read the tapes written on any of the 750,000 8mm tape drives in use today. Seamless integration with latest-generation 8mm libraries protects your 8mm investment.

**EXABYTE®** 

For more information on the Exabyte office nearest you: **The Netherlands** 31-30-548890, **Germany** (49) 69-95-925-220, **France**, (33) 1-69-41-16-17; **United Kingdom**, (44) 492-874855; **Asia**, 65-2716331.

©1995 Exabyte Corporation. Exabyte is a registered trademark and "Exabyte is Everywhere" and EXATAPE are trademarks of Exabyte Corporation. Exabyte Corporation, 1685 38th Street, Boulder, Colorado 80301 USA Phone (303) 442-4333.

Circle 68 on Inquiry Card (RESELLERS: 69).



## The Trouble with Microsoft

Microsoft "could reshape the Internet" ("The Greatest Show on Earth," July)? I hope not. They reshaped the world of operating systems and look what good they did to it. Thanks to Microsoft, we need a 486 to efficiently edit a plain ASCII file, so we can expect to need a direct T1 connection to The Microsoft Network to send E-mail. Fortunately, Microsoft won't reshape the Internet so easily. MSN is not exactly loved by many Internet users, and it won't exactly be welcomed into the Internet community.

The trouble with Microsoft is that speed and bugs don't really affect their products' success. Windows is the best example. The same could happen with MSN.

Petros Raptis  
Athens, Greece

prapti@leon.nrcps.ariadne-t.gr

## ISDN Lives

I want to compliment you on Sal Salamone's wonderful Core Technologies article "ISDN and Analog Access in One Package" (July). The entry of all of these modem manufacturers into the ISDN market will be good for ISDN. Salamone correctly pointed out that ISDN products are difficult to configure. I believe that these new ISDN product manufacturers will become instrumental in forcing the industry to adopt a simplified "plug and play" approach to ISDN.

Keep up the good work.

Paul D. Cook  
Paltine, IL

p.cook@computer.org

## I'd Never Be Without You, But . . .

Yours is the one computer magazine I'd never be without. That said, I suggest you reconsider comparative product reviews. Printers, monitors, and VGA cards are mature products, and even if we don't own the best laser printer under \$5000 or the best 17-inch monitor, the ones we have are good enough.

On the other hand, the review of telephony products in the May issue ("Small-Scale Telephony") was worthwhile because the field is very immature and products often differ significantly or have

significant flaws. These are the types of products we need to know about.

Andrew Mayo  
andrew@geac.co.nz



## Arithmetic 101

In your review of the Tadpole P1000 ("Red-Hot 100-MHz Portable Pentium," June), you claim it is "110 percent to 120 percent faster" than your reference machine. That would make the Tadpole over twice as fast as your 90-MHz baseline. I

think you meant "10 percent to 20 percent faster."

John Smythe  
Gainesville, FL

*Mr. Smythe is absolutely correct; we apologize for the error. —Rex Baldazo*

In "Break Up Your Network" (June), the author multiplies bits/second times bits/byte to arrive at a bandwidth in bits/second. I must be missing something here because I end up with a result of bits-squared/byte-second.

Andy Feibus  
VP Technology  
Process Systems and Integration Inc.  
amf@psi2.com

*The arithmetic is correct, but the units got scrambled. The error is in the label "Kbps," which is kilobits/second. It should have been "KBps," which is kilobytes/second. With that substitution, the units will cancel correctly.*

—Brett Husselbaugh

## FIX

We regret the following errors from our June roundup review of SQL tools ("Simple SQL"):

We stated that IQ Software's IQ for Windows does not provide a facility for resolving ambiguous join paths. IQ prevents ambiguous join paths by supporting rule-based table joins. The rules are stored in its repository. In reporting the print speed of IQ for Windows, we timed the speed of a query and print, instead of printing directly from the query screen. IQ's print speed is much faster than represented in the report. And IQ will indeed let you insert criteria from a static list.

Because of incomplete information supplied by IQ Software, the features table on page 220 contained errors. It should go like this:

Add descriptions for column/table names	Yes
Define dialog boxes for user queries	Yes
Start multiple instances of programs	Yes
Permits direct entry of SQL	Yes
Replace retrieved values with defined text/values	Yes
Generate partial reports	Yes
Insert criteria from static list	Yes
Add calculated fields without resubmitting query	Yes
Report on stored results	Yes
Define dialog boxes for user-query entry	Yes

IQ Software released version 5 of IQ for Windows soon after we completed our review of version 4.0. Version 5 adds significant enhancements and features. ■

## COMING UP IN OCTOBER

### • YOUR NEXT PC

Current PCs are built on a 15-year-old architecture. We look at the technologies that are going to bring computer hardware into the 21st century.

### • WINDOWS 95

The rubber meets the road as we test Windows 95. Plus, we'll look at some of the upcoming 32-bit applications especially designed for Windows 95.

### • LOTUS WORDPRO REVIEWED

Lotus has upgraded Ami Pro, added groupware features, and renamed it WordPro. We test this new addition to SmartSuite.

### • CATCH THE WAVE

A close look at the Power Mac 9500, code-named Tsunami, which finally weds PCI and the PowerPC.

### • FAXES ARE SERVED

Fax servers are no fun to install, but the payback makes it worth the hassle.



**FOR THE LAST TWO YEARS  
WE'VE WORKED WITH MICROSOFT  
TO MAKE SURE WINDOWS 95 USERS  
GET WHAT THEY NEED.**

**SYMANTEC.**



**Y**ou've waited. And waited. And now it's here. The most powerful PC operating system known to man and mouse.

But before you settle down to work in the 32-bit world of Windows 95, there are a few things you should know.

### INFECTION PREVENTION IN THE NEW WORLD.

First, Windows 95 doesn't have any virus prevention or protection built in.

And on the networked, file-sharing superhighway of life, the chances that your PC will be exposed to a virus are far greater

than you might think.

And guess what? Your old anti-virus software won't work in the brave new world of Windows 95. But thousands of old viruses will.

Which is why you should install Norton AntiVirus® for Windows 95 from day one.

Norton AntiVirus is verified to protect you from 100% of all viruses known to be in circulation.\*

*Norton AntiVirus for Windows 95 protects you from virus attacks.*

But you need more than just protection from a long list of known viruses. Which is all that ordinary anti-virus packages can offer.

Norton AntiVirus also offers you the most complete protection from unknown viruses. Thanks to our unique virus detection technology, Norton AntiVirus spots virus activity in your system and eradicates it before it can do any serious damage.

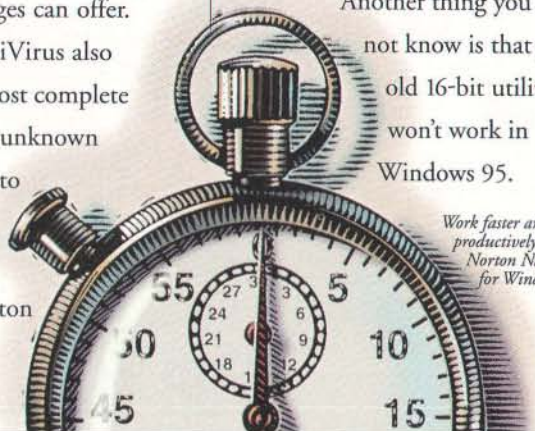
So even if you encounter a virus that was just created yesterday by some hacker with a bad frozen pizza habit, Norton AntiVirus will find it and stop it.

And when could you possibly need protection from unknown viruses more than in a brand-new operating system?

### A 32-BIT OPERATING SYSTEM DEMANDS 32-BIT PROTECTION.

Another thing you may not know is that your old 16-bit utilities won't work in Windows 95.

*Work faster and more productively with Norton Navigator for Windows 95.*



## PREVENTION, PROTECTION WINDOWS 95

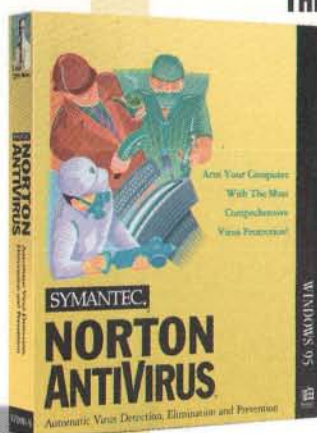
And the utilities included in Windows 95 itself won't give you much protection in a 32-bit world.

Only native 32-bit utilities can give you adequate system protection in a 32-bit environment.

Which is why you need to upgrade your utilities to Norton Utilities® for Windows 95.

The first thing Norton Utilities will do for you is optimize your system for Windows 95 with a Pre-installation Tune-up.

Then Norton Utilities runs continuously in the background, monitoring your system and automatically launching the right tools to maintain system performance and prevent system crashes.



\*Verified in independent tests conducted by NCSA and VSUM, July 1995. Norton AntiVirus and Norton Utilities are registered trademarks and In Australia, call 2-879-6577. In Europe, call 31-71-353111.

1995. \*\*Trade-up editions will run only when specified Symantec, Central Point, McAfee or Norton Navigator is a trademark of Symantec Corporation. All other brand names or trademarks



And if something does go wrong, Norton Utilities gives you the data recovery tools users have relied on from day one.

So from the day you install Windows 95, your system is stable and your files are protected.

**THE MORE WORK YOU DO,  
THE MORE WORK NORTON  
NAVIGATOR WILL DO FOR YOU.**

Windows 95 has lots of terrific features to make life easier. Like Plug 'N Play. And long file names.



*Norton Utilities keeps  
your data safe from harm.*

You can plug into your Internet connection right from the Norton File Manager. Search for text strings within files at least ten times faster. (In fact, the more files you have and the bigger they are, the more time you'll save.)

And copy a file anywhere on your hard drive or on the network with just one click. Instead of click

click click  
click click  
click click  
(are you  
tired of  
clicking?)  
click click

## AND PRODUCTIVITY FOR FROM DAY ONE.

But what about getting even more out of Windows 95? Like getting more done in less time.

With Norton Navigator, you can navigate through your desktop five times faster than in Windows 95. Be more productive with multiple project-oriented desktops. Open the files you need most in a single click.

And that's just the first minute.



*Norton Folder Navigator  
extends your menu power.*

click click. Which is generally how long it takes to copy a file in Windows 95.

Norton Navigator also lets you use long file names for most 16-bit applications.

And gives you loads of other time-saving tools like built-in PK-Zip compatible file compression and the ability to delete, move, zip or encrypt from any Open or Save dialog box.

So why waste time wading up and down menus, clicking your life away? Every minute counts.



**SYMANTEC.**

## WINDOWS 95 IS A GREAT PLACE TO BE. WE GUARANTEE IT CAN BE EVEN BETTER.

Like all Symantec products, Norton AntiVirus, Norton Utilities and Norton Navigator come with a 60-day money-back guarantee. And we'll even make it easy for you to trade up from your current 16-bit Symantec and Central Point products.

So on the day you load Windows 95, make sure you're ready. With the new Norton AntiVirus,

Norton Utilities and Norton Navigator from Symantec.

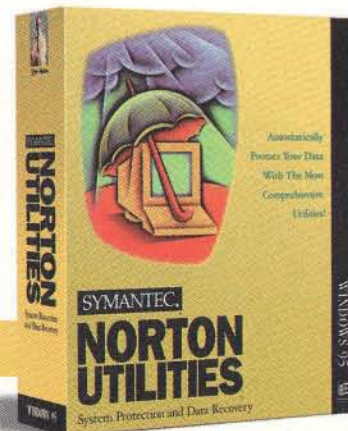
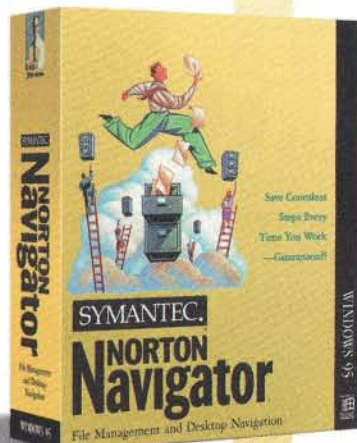
### GET YOUR TRADE-UP EDITION TODAY.

Norton AntiVirus for Windows, PC Tools, Norton Desktop for Windows, Central Point Anti-Virus, McAfee VirusScan and Dr. Solomon's Anti-Virus owners trade up to Norton AntiVirus for Windows 95 for \$29.95.\*\*

Norton Utilities, Norton Desktop for Windows, and PC Tools owners trade up to Norton Utilities for Windows 95 for \$59.95.\*\*

Norton Desktop, PC Tools, XTree and Norton Commander owners trade up to Norton Navigator for Windows 95 for \$39.95.\*\*

To purchase, visit your software store or call us at 1-800-450-9760 ext. 9AP4.



Dr. Solomon's products are already installed. Check with your software store for qualifying versions. Price does not include shipping and handling or any applicable sales tax. Symantec, are the property of their respective owners. ©1995 Symantec Corporation. All rights reserved. Visit us on the Internet at <http://www.symantec.com>. In Canada, call 1-800-365-8641.

Circle 93 on Inquiry Card.



# NEWS & VIEWS

16-BIT SOFTWARE STALLS THE P6

## P6 Weakness Revealed

When running legacy applications, a fast Pentium may outperform the first P6 processors

TOM R. HALFHILL

**T**rick question: When is a Pentium *faster* than a P6? Surprise answer: When it's running 16-bit software, including DOS and Windows 3.1.

Intel's latest benchmark testing reveals that a 133-MHz Pentium consistently outruns a 150-MHz P6 when executing the 16-bit code found in today's most popular software. Even a 100-MHz Pentium runs neck and neck with a 150-MHz P6.

Theoretically, the sixth-generation P6 chip should blow the fifth-generation Pentium out of the water. The P6 has three-way superscalar superpipelines, speculative

execution, out-of-order execution, additional registers, 2.2 million more transistors, more headroom for higher clock speeds, a closely coupled secondary cache, and a higher price tag (see "Intel's P6," April BYTE). But some of those fancy features actually *slow down* the P6 when running 16-bit code.

The problem, says Intel, is with today's installed base of software, not with the chip. The P6 is optimized for 32 bits.

When Intel engineers began designing the P6 about four years ago, they figured everyone would be running 32-bit software by now. After all, Intel's first 32-bit x86 processor (the 386) dates back to 1985. But the industry hasn't moved quite as fast as Intel and others expected: Most PCs today run 16-bit Windows. When Intel ran the SysMark application-level benchmark programs on a P6, old-generation software embarrassed Intel's next-generation chip.

It's certainly not unusual for a new processor to deliver less-than-optimum performance unless old software is recompiled to take advantage of the new design. That's especially true of RISC processors. While the P6 is still a CISC chip, it adopts several RISC-like techniques. However, it's definitely unusual for a new CPU to run old software *slower* than existing CPUs that share the same

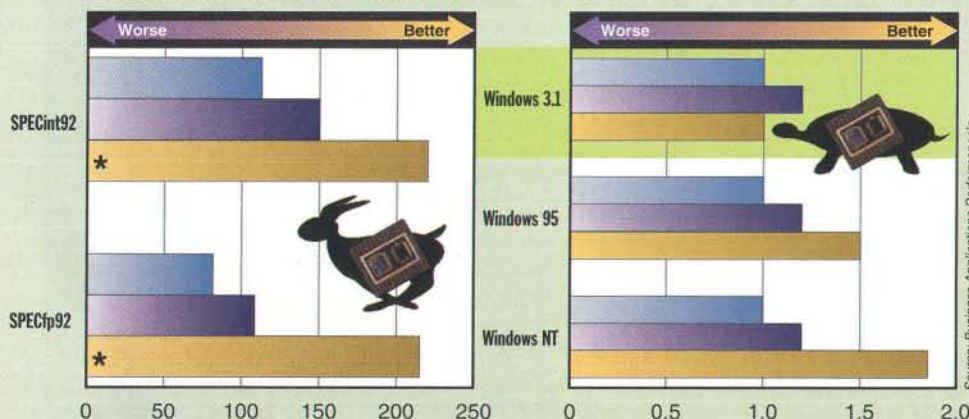
## Why Legacy

The Pentium currently outperforms the P6 when running 16-bit programs under Windows 3.1 due to a combination of factors. They include the design of the P6 and the hangover of legacy DOS and Windows code.

As described in "Intel's P6" (April BYTE), instructions passed to the P6 are converted into equivalent micro-operations that are loaded into a 40-element circular buffer. Instructions in the buffer pass to the execution unit, which processes between three and five instructions simultaneously, if the data for the specific instruction is available.

If instruction B references a particular register, and instruction A, which precedes B in program flow, also writes to that register, B must wait for A to complete. Therefore, the fewer the dependencies, the faster the

### P6 Faster in Raw Performance ..... but Slower for 16-bit Applications



The P6 outruns the fastest Pentiums when measured by low-level 32-bit benchmarks, as seen in these SPECmark estimates from Intel. Although Intel initially planned to introduce the P6 at 133 MHz, it's now likely the chip will debut this fall at speeds of 133, 150, and 166 MHz.

\*Intel estimates. All numbers are based on a 256-KB secondary cache.

Although the P6 outruns the fastest Pentiums in low-level 32-bit benchmarks, a 150-MHz P6 is outraced by a 133-MHz Pentium and matched by a 100-MHz Pentium when running 16-bit programs under Windows 3.1, as seen in these preliminary benchmarks from Intel. With 32-bit Windows 95 or Windows NT, however, the P6 meets expectations. As of this writing, Intel has not permitted BYTE to run our own benchmarks on the P6.

■ Pentium 100 MHz ■ Pentium 133 MHz ■ P6 150 MHz

Source: Business Applications Performance's SysMark benchmarks.



# Code Snags the P6

instructions can be delivered to the execution units.

To conserve on the P6's transistor count, Intel decided to shadow (i.e., allow multiple independent instances) the "true" registers as full 32-bit entities only. The result is that any instruction that alters any part of a register will hold up a following instruction that uses any part of the same register, even if the instructions are logically independent. An `ADD AL, 6` holds up a `MOV BX, AX`.

If this were a completely 32-bit world (as Intel's engineers had hoped it would be by now), any instruction referencing a register would be held up by, at most, one preceding instruction, and the P6 would "fire on all cylinders." Similarly, if all programs manipulated the CPU registers only 16 bits at a time, the P6 would per-

form well. Unfortunately, a great deal of code, especially in the DOS and Windows world, manipulates registers as 8-bit entities here, 16-bit entities there, and sometimes 32-bit entities. This "mixing" of data sizes bogs the P6 down, because it has to spend so much time "piecing" the 32-bit registers together from 8- and 16-bit sub-units.

Another source of friction for the P6 arises from the ever-dreaded segment registers often manipulated in 16-bit DOS and Windows programs. Again, to skirt what would have been a tremendous multiplication of complexity, the P6 engineers elected not to virtualize the segment registers. So, whereas general CPU registers can be shadowed, only one global instance exists for each segment register. The result is that the arrival of a segment

register load instruction "serializes" the CPU: No other instructions can proceed until the load completes.

Furthermore, any instructions that had already been started but appear in the program flow after the segment register load instruction must be dumped and restarted. The "tear it up and start from scratch" tactic is necessary because the source for all instructions and data following the segment load is in question.

Ironically, none of this would be of any significance if the designers of the P6 hadn't made a few excusable miscalculations. In one of the larger mispredicted branches we've ever seen, the P6 engineers in 1990 estimated that most code today would be 32 bits, and that the standard for chip technology, including the Pentium, would be at 0.6 micron running

at around 100 MHz. However, hardware again outpaced software. Today's typical PC runs a mixture of 16-bit code on 32-bit OSes. Meanwhile, the latest Pentium is produced on a 0.35-micron process and soon will run at 150 MHz.

The first P6 will not be manufactured on a 0.35-micron process, however. Instead, Intel says it will make the first P6 chips on a more conservative 0.6-micron process. Once it has worked the bugs out at 0.6 microns, Intel says it will move to a more aggressive 0.35-micron process. The company estimates there will be an eight-month period when a similarly clocked Pentium will outpace the P6 in the special circumstances we've described. But once Intel moves to 0.35-micron manufacturing, the P6 will race ahead. —Rick Grehan

basic architecture. (For more information on why this is, see the text box "Why Legacy Code Snags the P6.")

The P6 lives up to expectations with 32-bit code. Intel's benchmarks show that it easily outperforms the fastest Pentiums when running 32-bit applications on a 32-bit OS, such as Windows 95 or Windows NT. Interestingly, however, the P6 does much better with NT than it does with Windows 95. Intel says that there are vestiges of 16-bit code in the Windows GDI (Graphical Device Interface), while NT is thoroughly 32-bit.

The P6's poor showing with 16-bit software is probably not as serious as it seems. High prices will initially limit the P6 to servers and workstation-class desktop systems, whose performance-minded users will almost certainly be running 32-bit OSes and applications. If the P6 follows an adoption curve similar to the Pentium's, it will not appear in mainstream PCs until 1997. By then, 80 percent of new PCs will ship with a 32-bit OS, according to International Data (Framingham, MA). And Windows 95 should accelerate the migration to 32 bits.

Intel says the P6 will get a performance boost when the company moves from its current 0.6- to 0.35-micron process. That raw performance boost should let the P6 outperform the Pentium in running legacy 16-bit software. Until then, anyone who is contemplating the purchase of a P6 should be forewarned: If you're running 16-bit software, the Pentium delivers more bang for fewer bucks.

## CALCULATORS

# PC Power Comes to the Calculator



The TI-92 has a 240- by 128-pixel display. You can split the display to view two applications simultaneously. It includes a QWERTY keyboard and an I/O port for data transfer. It's about the size of a videocassette tape. TI ((800) 842-2737; fax (817) 774-6074; ti-cares@ti.com) says the TI-92 will sell for about \$200.

thors of the Derive algebra that's published by Soft Warehouse in adding the interactive-geometry and symbolic-manipulation features. Thanks to those joint efforts, you can not only deter-

**H**igh-end math capabilities such as symbolic calculus and Euclidean geometry are migrating from PCs to \$200 calculators. Texas Instruments (Dallas, TX) says it will release a new calculator called the TI-92 later this year. This calculator delivers interactive geometry, symbolic manipulation, statistics, and even 3-D graphing with an easy-to-use graphical interface.

TI collaborated with the creators of the Cabri Geometry II software at the Université de Joseph Fourier as well as the au-

thors of the Derive algebra that's published by Soft Warehouse in adding the interactive-geometry and symbolic-manipulation features. Thanks to those joint efforts, you can not only deter-

mine the integral (that's the area under a curve for those of you who haven't been to calculus class lately) of a curve, you can also get the formula that's used for finding the integral (e.g., the TI-92 will tell you that the formula for determining the integral of  $x^2+2x+2$  is  $x^3/3+x^2+2x$ ).

TI says that the new calculator (see the photo) lets teachers equip a math lab much less expensively. The reaction from BYTE's college interns to the new calculator was universal: "I want one."

—Dave Andrews



## WINDOWS 95 DEVELOPMENT TOOLS

# Delphi and VB Turn 32

**V**isual development tools from Borland and Microsoft will soon let you create 32-bit programs that take advantage of the new features and UI (user interface) elements in Windows 95. In mid-September, Microsoft (Redmond, WA) plans to release 32-bit Visual Basic 4.0. Borland International (Scotts Valley, CA) says it will release a 32-bit version of Delphi within 90 days of the commercial availability of Windows 95. These products add stronger support for client/server development and OLE integration. Another 32-bit bonus is Windows NT compatibility. Windows NT 3.5 can be both the host and the target of VB 4.0 and Delphi.

Although the 32-bit code these tools generate will not run on 16-bit Windows 3.1 or Windows for Workgroups, Microsoft and Borland will continue to support their 16-bit versions. Both VB 4.0 and Del-

phi make the migration to 32-bit Windows development relatively simple. In many cases, you can recompile existing 16-bit code.

Perhaps the biggest obstacle to Windows 95 migration will be the transition to OLE-based custom controls. You can't use 16-bit VBXes (Visual Basic custom controls), which played a major role in VB's success, to build 32-bit software. Instead, you'll use 32-bit OLE controls (formerly called OCXes) that improve on VB's component architecture. Fortunately, many third-party developers have started migrating their VBXes to the OLE model.

Borland's new version of Delphi, when used with Microsoft's Control Development Kit, can create custom controls. However, VB 4.0 cannot do this. This gives Delphi an advantage over VB.

Because VB 4.0 still relies on a run-time interpreter, Delphi will also maintain its per-

formance lead. VB's interpreter is the same Object Basic engine that's found in Microsoft Office's VBA (VB for Applications), but interpreted VB programs generally are not as fast as programs created with Delphi's Object Pascal compiler. In fact, the new version of Delphi will share Borland C++'s 32-bit optimizing compiler.

Although VB cannot build OLE controls, both VB 4.0 and the new version of Delphi will let you create OLE automation objects. These are stand-alone code libraries that expose their routines to other OLE-aware programs.

In VB, you create these objects with a new type of module called a class module, containing as few as three lines of code. Public variables in this module become properties, and public subroutines and functions become methods. Other OLE-aware programs can browse these modules, modify

their properties, and call their methods. This lets VB create distributed objects for three-tiered client/server systems. You can isolate business rules in OLE objects, separated from both the front-end client application and the back-end enterprise server.

Also new to VB 4.0 is an add-in architecture that's similar to Adobe Photoshop plug-ins. Previously, outside developers had to hack VB to add design-time utilities, such as code formatters and debugging tools. Microsoft now formalizes that architecture by letting OLE-based add-ins appear on a VB menu.

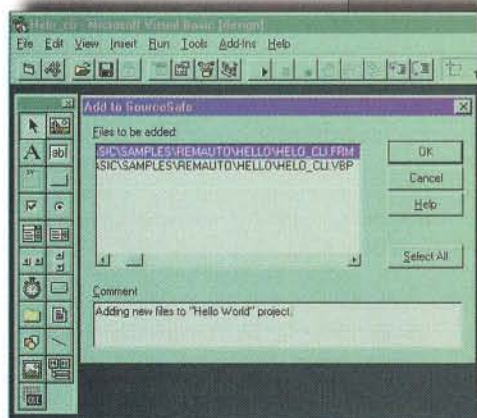
A new IF...THEN statement in VB conditionally compiles blocks of code. If a program calls functions available only in the full Win32 API (e.g., OpenGL graphics), you can tell VB to ignore that code when targeting the Win16 API.

Client/server developers will appreciate the new 32-bit database engines in Delphi and VB. Delphi will have 32-bit asynchronous I/O, new drivers for DB2, deferred updates for transactions on multiple tables, and the ability to execute transactions against local dBase and Paradox files. The new Enterprise Edition of VB 4.0 will include the Jet 3.0 database engine and other client/server features.

Of all the 32-bit improvements, however, perhaps the most important one is the move to 32-bit OLE controls. Unlike VBXes, which are closely tied to the VB architecture, OLE controls will be supported by a number of development tools. This will give visual programmers much more power at their disposal.

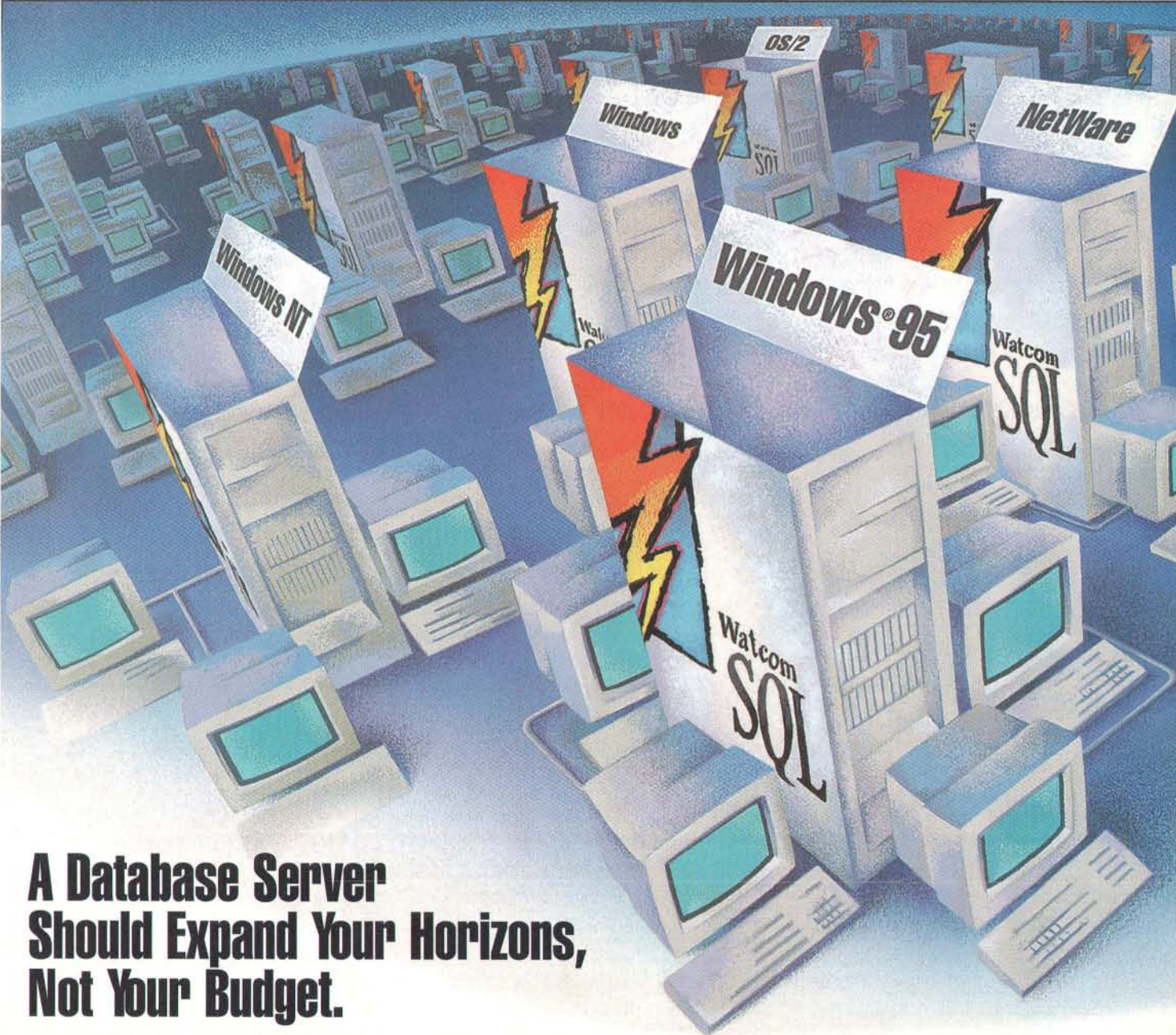
—TRH

▼ Visual SourceSafe, a source code management tool that Microsoft recently acquired from One Tree Software, helps programming teams using the Enterprise version of Visual Basic 4.0 create complex, distributed applications.



▲ The new 32-bit Delphi lets you create programs that have Windows 95 UI (user interface) elements, such as tabbed dialog boxes. For maximum performance, these features are implemented as Delphi-native controls, not OLE controls. Also, note the Pentium-Safe FDIV compiler option.





## A Database Server Should Expand Your Horizons, Not Your Budget.

Presenting Watcom SQL, the industrial strength database server for simple and affordable widespread deployment of PC client/server applications. Watcom SQL's advanced technology offers unparalleled simplicity of operation and performance, making it ideal for workgroup, desktop and mobile applications — from headquarter's departments to remote branch offices to mobile field personnel on the go.

**Installed and Running in Minutes.** Setting up Watcom SQL is quick and easy, taking only a few minutes. But for real convenience, many users build it right in to the installation process of their applications. Imagine, real SQL database deployment so easy that end-users don't even know it's there!

**High Performance Right Out of the Box.** The self-tuning query optimizer is the key to Watcom SQL's blazing performance. Not only does it tune each individual query, it delivers high speed performance without administrator attention. Better still, it comes as standard equipment in every box.

**Big Performance. Small Footprint.** Not only is Watcom SQL powerful, it's incredibly efficient as well. Because it was designed for PC environments, it minimizes its use of disk and memory — just 4 MB

of disk and less than 1 MB of memory. And Watcom SQL also runs quite comfortably on the same machine as an application — particularly important in mobile, standalone and peer-to-peer networks. Of course, on advanced servers, Watcom SQL shines by taking full advantage of both increased memory and RAID storage.

**Yes, The Price Really is That Low.** Watcom SQL is priced to make widespread deployment affordable. A 6-user server is only \$795\*. And for volume deployments, our "Gold Disk" licenses offer significant savings.

So, though your budget may not be limitless, your horizons are with Watcom SQL — from one server to thousands on Windows, Windows 95, Windows NT, NetWare or OS/2. With hundreds of thousands of servers already installed, Watcom SQL is the proven choice for widespread, industrial strength deployment.

Expand your horizons. Call us today for the opportunity to try Watcom SQL 4.0 free for 30 days, or to reserve your seat at a free half day seminar on "Cost-effective Widespread Deployment of Client/Server Solutions" in a city near you.

**1-800-265-4555**

**Watcom**  
A Powersoft Company



## Get a Fast Start on the Automation Learning Curve!

Devoted exclusively to the computing needs of chemical engineers, Chemputers Europe II brings together leading software developers and users from around the globe. This year's conference will feature dozens of papers from key innovators in engineering software, and from pioneering chemical manufacturers and engineers testing and using the latest software.

An adjoining Demonstration Hall will feature exhibits by many of the companies participating in Chemputers Europe. There will be ample opportunities to meet with these leading vendors to obtain more information, and to "test drive" the industry's hottest new products.

The Chemputers Europe II program is broadly divided into two tracks: Process and Plant Design, and Plant Operations and Management. Within these tracks, the following sessions and papers have been scheduled:



# Chemputers

## **PROCESS AND PLANT DESIGN** (includes process simulation, estimating, CAD and design optimization)

### **Detailed Design, Estimating and Scheduling Software**

K. Adamson, Product Manager, EA Systems Inc. and  
R. Steinberger, Director, Icarus Corp. USA

### **Process Simulation in Chemistry and Environmental Technology**

W. Schmidt, Chemstations Europe, Germany

### **The Plant Data Life Cycle**

G. Stiksmas, Project Automation Manager, Fluor Daniel,  
Netherlands, and Frank Joop, PDS Manager, Intergraph,  
USA

### **Dynamic collaboration: The next decade of process computing**

John Voeller, Black & Veatch, USA

### **The design of Steam Reformers using Computational Fluid Dynamics**

F.P. Waterrus, C. van Leeuwen, Kinetics Technology  
International B.V., The Netherlands

### **CFD studies on the influence of impeller spacings on Flow Fields and Mixing Times in Stirred Vessels**

R.S.H. van der Geest, Research Scientist, Unilever BV,  
The Netherlands

## **PLANT OPERATIONS AND MANAGEMENT**

(includes process control, manufacturing execution systems, advanced control, engineering document management, training, maintenance and environmental monitoring)

### **A structured approach to Automating Complex Batch Processes**

A. Pampel, AFP Consulting; J. Vreysen, System Manager,  
Elsag Bailey Process Automation, Belgium

### **Large-scale Process Simulation-The System Architecture Requirements**

P. Van Santen and J. van Loon, Marketing Manager, Setpoint BV, The Netherlands

### **Online Optimization of Process Operations**

S. Mullick, Research Scientist, Simulation Sciences, USA

### **Standardized Plant Life Cycle Data**

Ben Maasman, Akzo Nobel Engineering, Netherlands

### **Application of multivariable control to MTBE production**

Doug Robertson, Staff Engineer, DMC Corp., USA

### **A new approach to online optimization**

Peter Winter, European Director, Sacda UK

### **Computerized process management boosts industry profits**

C.W. Taylor, Technical Manager, Marex Technology,  
England

### **Manufacturing Execution Systems—Requirements and New Developments (Capisce)**

T. Allweyer, Research Scientist, Institute for Information  
Systems, W. Saarland

### **Manufacturing Execution Systems: A Corporate Initiative with a Supplier's Collaboration**

Phil Hannay, Cargill Inc., USA, George Turanchik, GSE  
Process Solutions Belgium NV, Belgium

### **Plantwide information systems: Application in a mineral oil treatment plant**

J.E. Hille, Eurostill B.V., The Netherlands



**Manufacturing Execution Systems in the production of chemicals**

B. Adams, Vice Pres., Incode Europe, England

**PDXI Progress report**

M. Dalton, Eastman Chemical Co., USA; Stewart Goldfarb, Simulation Sciences, USA (Chairman and Vice-Chairman of PDXI Technical Committee)

**RELIEF: A computer package for Emergency Pressure Relief Studies**

J.S. Duffield, EU Joint Research Center, Italy

**Advanced Training Simulation for Sulfur Recovery Units**

A.N.S. Mak, Comprimo BV; C. Geen, Sacda UK Ltd.

**Multi-purpose dynamic simulation-Making the most of simulation investments**

Richard Bailey, BP Intl., UK; Mark Matzopoulos, Cape Software Ltd., UK

**EGIS: A contribution to the standardization of environmental software and databases for the chemical process industries**

K. Kaiser, J. Schwab, Technidata GmbH, Germany

**PLUS:** *The Internet for Chemical Engineers: A hands-on session of demonstrations and talks on what is happening in this fast-moving new medium*

**PLUS:** *Panel Discussions*

*Each track will conclude with a panel discussion of leading developers in process design and plant operations.*

*Discussion topics include:*

**DYNAMICS OF PLANT CONTROL AND SIMULATION**

**INTEGRATING DESIGNS AND DATA IN THE PLANT LIFE CYCLE**

PROGRAM SUBJECT TO CHANGE. ADDITIONAL PAPERS ARE NOW BEING SCHEDULED!

**Hosted Meetings**

A number of related meetings are being held in conjunction with Chemputers Europe II. These meetings will provide additional opportunities for exploring specific topics in more detail. The current lineup:

**ECOS at Chemputers**

Simulation Sciences' European Conference on Open Simulation. Free to all Chemputers attendees, ECOS features presentations on the implementation of Microsoft and other standards in PROvision. Oct. 12.

**PlantSTEP European Industry Review Board**

Emerging standards for Electronic Data Interchange, focusing specifically on the activities of STEP consortium. Free to Chemputers attendees. Oct. 10.

**European Batch Forum (EBF)**

EBF's Annual Fall Meeting will focus on the recently completed SP88 Part I standard for batch control, and will look at the implementation of both Part I&II of this standard. EBF attendees can participate in the Chemputers Conference at no extra charge. Oct. 11-12.

# Europe II

October 10—12, 1995 Noordwijk, The Netherlands

**Registration Form**



**Chemputers Europe II  
Conference  
and Exhibition**

Liebigstrasse 19  
D 60323 Frankfurt am Main, Germany  
Tel: 49.69.7140.7137  
Fax: 49.69.7140.7147

1221 Avenue of the Americas  
New York, NY 10020  
Tel: (800) 845.5056  
Fax: (212) 512.6111

Registration fee: \$350 (NGL 570). This includes two days of technical sessions, plus the PlantSTEP meeting on Oct. 10, day/evening hours at the demo hall, conference materials, continental breakfast, lunch and a reception hosted by Chemical Engineering.

☐ Yes! I would like to attend Chemputers Europe II

☐ Enclosed is a check for \$/NGL \_\_\_\_\_ payable to  
Chemical Engineering

☐ Charge my credit card: ☐  ☐  ☐ 

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

Postal Code/City \_\_\_\_\_

Country \_\_\_\_\_

Phone \_\_\_\_\_

Fax \_\_\_\_\_

Cardholder Name \_\_\_\_\_

Card Number \_\_\_\_\_

Exp. date. \_\_\_\_\_

Signature \_\_\_\_\_



**Chemical Engineering**

A Division of The McGraw-Hill Companies





## PC PROCESSOR TRENDS

# New 486 Chips Deliver Inexpensive Power

The 486 is reaching the end of its life, but it isn't dead yet. Advanced Micro Devices (Sunnyvale, CA) has developed two chips that shatter 486 speed barriers and offer Pentium-level performance at low-end prices. Meanwhile, Cyrix (Richardson, TX) has developed an unusual CPU that's a cross between a 486 and a 586-class chip.

Although AMD's new processors run internally at 120 and 133 MHz, they use clock-divided buses to remain compatible with existing motherboards. The 120-MHz 486 has a 40-MHz bus and delivers integer performance comparable to a 75-MHz Intel Pentium (see "AMD's 120-MHz 486: Bargain Power"). It began shipping this summer.

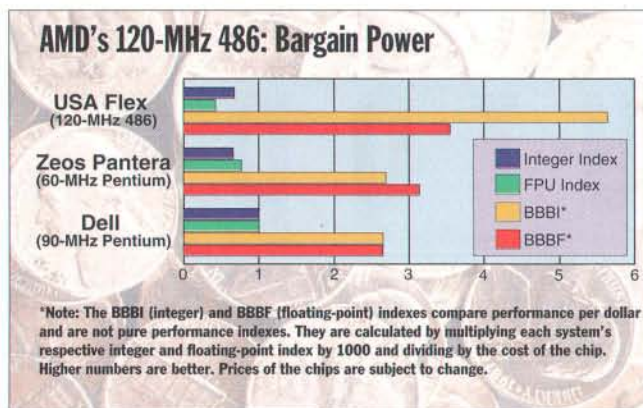
AMD's 133-MHz 486 chip, which is due later this year, has a 33-MHz bus and a 16-KB unified write-back cache, which is twice as large and more efficient than the 8-KB write-through caches found on most 486 chips. However, due to its slower bus and the diminishing returns of pushing an older design to higher clock speeds, the 133-MHz 486 will offer only marginal performance improvement over the 120-MHz chip.

Cyrix is trying to get around the problem of the 486's diminishing returns by introducing a hybrid design called the 5x86 (formerly known as the M1sc). The 5x86 will likely ship in volume by the end of this month.

Depending on your point of view, the 5x86 is either a souped-up 486 or a stripped-

down version of the M1, Cyrix's 586-class processor. Gone are the most advanced features that are supposed to make the M1 perform 30 percent to 50 percent faster than a Pentium: superscalar pipe-

up the Pentium and the sixth-generation P6? One reason: Both AMD and Cyrix are late in delivering their fifth-generation chips (neither the AMD K5 nor the Cyrix M1 will ship in quantity before 1996).



BYTE's native-mode benchmarks indicate that a system from USA Flex ((800) 872-3539) based on AMD's 120-MHz 486 processor achieves integer performance comparable to that of the more expensive 60-MHz Pentium. The system lacks the FPU performance of a Pentium, however. The USA Flex desktop PC with 8 MB of RAM, no monitor, a 545-MB hard drive, a 3½-inch floppy drive, a 256-KB write-back cache, a mouse, and a 1-MB DRAM video accelerator card costs \$1049. —DA

lines, speculative execution, extra registers, and a 64-bit data bus. Retained are several features typically found only in fifth-generation microarchitectures: branch prediction, data forwarding, an independent load/store unit, an 80-bit FPU, 64-bit internal data paths, and a 16-KB unified write-back cache.

Internally, Cyrix's 5x86 runs at 100 MHz. Bus speeds can be 25, 33, or 50 MHz. Like a Pentium OverDrive, the 5x86 fits in a 32-bit 486 socket. Future versions will fit into 64-bit Pentium sockets and attain core speeds of as high as 200 MHz.

Why bother with sub-586 designs when Intel is ramping

Several vendors, including Cybermax, Liuski Systems, USA Flex, and Vobis, say they will use AMD's 120-MHz 486. However, at press time, major system vendors such as Compaq, which already uses AMD processors in some systems, had not committed to using AMD's new 486 chips. One vendor, which requested anonymity, said it would not use the 120-MHz 486 because it thinks Pentium prices will drop dramatically this fall.

Prices to PC manufacturers for these crossover chips range from \$120 for AMD's 120-MHz 486 to \$147 for the Cyrix 5x86 (in quantities of 1000). That means complete systems can sell for under \$1500, which

## Whatever Happened to...

### TI's Rio Grande Chip?

(see "TI Charges into the Notebook CPU Wars," April 1994 BYTE, p. 36)

Texas Instruments hoped that manufacturers of sub-notebooks would flock to its Rio Grande chip, a 486SX-class processor that integrated a PCI (Peripheral Component Interconnect) bus interface and memory controller with aggressive power management and low power consumption (3.3 V). But two factors helped shelve the chip.

One was that as TI was preparing to release the 486SX-class chip (it had no FPU), the company's notebook partners were shifting to higher-performing 486 processors. Also, it turned out that customers weren't buying a lot of subnotebooks at the time because notebooks that weighed less than 4 pounds had too many compromises.

TI is back in the notebook and consumer markets with an 80-MHz 486-class processor called the TI486DX2, which should enter volume production this month. TI cites the first-quarter 1995 Storeboard Channel Tracking Service, which reported that 57 percent of PCs sold through retail channels in the U.S. were based on 486DX-class processors.

—DA

is a key price point in retail channels.

The pumped-up 486 chips should prosper in low-priced desktops and notebooks. For corporate and technical users, however, true 586-class chips look like a better buy. They're a safer long-term investment, and they offer superior performance, especially for floating-point tasks.

—TRH



# COREL CD OFFICE Companion™

*The best CD to complete your office suite*

## Internet Web Browser and Fax

### Corel Web Mosaic™

Built-in playback support for AIFF and AU audio files  
Direct display of GIF and JPEG images  
Full printing applications

### CorelFAX™

Send faxes from within any Windows application  
Built-in OCR and TWAIN-compliant scanning  
Send and receive faxes in the background

## Personal Information Manager

### Corel PLANNER™

Cross-reference information easily by linking related items together  
Daily, weekly, monthly and yearly calendar views for planning appointments and activities

## Fonts

### Corel FONT MASTER™

500 high-quality Bitstream® and URW™ fonts  
Preview fonts, assemble font groups, install and de-install TrueType® fonts on the fly



## Business Graphics

### CorelFLOW™ 2\*

- 2,000 "drag and drop" symbols
- 90 Smart Symbol Libraries
- Built-in spell checker
- Automatic shape connectors

## Clipart and Photos

### Corel GALLERY™ 2\*

- 15,000 clipart images
- 200 photos and 75 sound clips
- Full-color reference guide of each clipart image

## Complete Electronic Reference

### Corel BOOKCASE™

- Electronic encyclopedia, dictionary, contemporary quotations, plus 3 almanacs including a business and sports almanac
- *Correspondence Library*—700 standard business letters

## Multimedia Utilities

- *Corel CD Audio™*—Listen to your favorite audio CD from your CD-ROM drive
- *WinTune™ 2.0*—System diagnostic indicator to optimize the performance of your PC
- *WinDat™ .WAV editor*—Record and edit sound clips
- *Corel Screen Saver and Wallpaper Flipper*

You've got your office suite... but to maximize your productivity you need Corel CD Office Companion. It's value-packed with World Wide Web and fax communications, business graphics, PIM, clipart, fonts, reference libraries and multimedia utilities—all on one convenient CD-ROM!

*Corel CD Office Companion—the ideal complement to:*

- Microsoft® Office
- Novell® PerfectOffice™
- Lotus SmartSuite®

**Incredible power and value all on one convenient CD-ROM**



\* Clipart, font and photo libraries vary from the standalone versions of CorelFLOW 2 and Corel GALLERY 2.

**\$99<sup>99</sup>\***

Part # 449124  
US\$ plus applicable taxes.

**STAPLES**  
The Office Superstore

**1-800-333-3330**  
Call for the store nearest you!

KUR-0141

**COREL®**  
custserv@corel.ca  
Call now for faxed literature!  
1-613-728-0826 ext. 3080

Microsoft is a registered trademark of Microsoft Corporation. PerfectOffice is a trademark of Novell, Inc., and SmartSuite is a registered trademark of Lotus Development Corporation. Microsoft Corporation, Novell, Inc., and Lotus Development Corporation make no endorsement of Corel or Corel CD Office Companion.

Circle 64 on Inquiry Card.



## INTERACTIVE COMPACT DISCS

# Interactive Music Videos Arrive for Macs and PCs



When you play Todd Rundgren's *The Individualist* interactive CD in a multimedia desktop system, you get the equivalent of a music video accompanying each song. You can instantly cue to any audio track chorus or verse by highlighting an interactive lyric text. The CD also has footage of a live performance taken from Rundgren's video *No World Order Tour*. This lets you play video director by choosing among four different camera positions to produce custom music videos of the show.

out end of the audio session won't try to play the computer data.

Todd Rundgren, a well-known cybertainer in the music industry, is making his new CD, *The Individualist*, available only in CD+ format. Rundgren describes *The Individualist* (see the screen), which should be available by the time you read this, as a "multimedia album" designed to run on both PCs and Macs. With the CD in a multimedia desktop system, you get the equivalent of a music video with each song.

Major industry players—including Apple, Microsoft, Philips Electronics, Sony, and the Recording Industry Association of America, which is the trade group that represents U.S. record labels—have endorsed the CD+ Blue Book specification. Microsoft is also backing CD+ with its release of *Symmetry*, a CD+ development and authoring tool that supports WinG graphics acceleration, WinToon cartoon animation, and Surround Video. Macromedia (San Francisco, CA) also expects to release its

Director Enhanced CD Toolkit for the Mac and Windows this fall.

However, CD+ is not the only interactive CD format. Content producers are also using ActiveAudio's Track Zero format, which was announced last year. Track Zero has advantages over CD+. Unlike CD+, which requires a multisession CD-ROM drive, Track Zero works on single-session CD-ROM drives as well. And although Microsoft says it will include full CD+ Blue Book support in Windows 95, the company hasn't said if it will support the format in Windows 3.1 or NT. ActiveAudio already has drivers for the Mac, as well as the three versions of Windows.

Whether they use Track Zero, CD+, or another format, these new interactive CDs are another example of how PCs and Macs are becoming entertainment appliances.

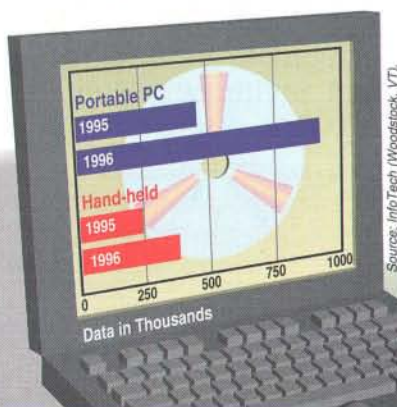
—Greg Loveria

Imagine listening to glorious digital stereo on your car's CD audio system. But when you arrive home and put the same CD into your computer's CD-ROM drive, you can listen to the audio, plus view interactive music videos, lyric sheets, artist biographies, and interviews. The CD+ (also known as Enhanced Music Compact Disc) format lets you do all the above and brings the audio CD into the era of interactive content delivery using desktop multimedia systems.

CD+ addresses the problem with today's interactive CDs, in which the lyrics, photos, graphics, and video are stored on track 1. When you play track 1 of current interactive CDs on a standard audio CD player, the resulting grating, buzz-saw sound can damage the speakers. The new CD+ format eliminates this problem. CD+ is a two-session format that works on current-generation multisession CD-ROM drives and all standard audio CD players.

CD+ lets content producers put audio tracks of first-session audio as standard CD-DA (Red Book Compact Disc Digital Audio) alongside CD-ROM computer data that was recorded in a second session. An audio CD player that encounters the lead-

## CD-ROM Notebooks Proliferate



### Benefits

- Multimedia presentations
- Distributed databases
- Entertainment to go

### Barriers

- Increased weight
- Shorter battery life
- Higher cost

The number of notebooks with integrated CD-ROM drives will almost double in the next year, according to InfoTech, the international CD-ROM consultancy (Woodstock, VT). At the Computex show in Taipei, which should portend what you'll see in retail outlets this fall, practically every notebook vendor showed at least one CD-ROM-equipped portable. Sales of CD-ROM-equipped hand-held models will probably be less than notebook PCs, although InfoTech says gaming machines could change that forecast.

### Web Addresses for Interactive CD Information

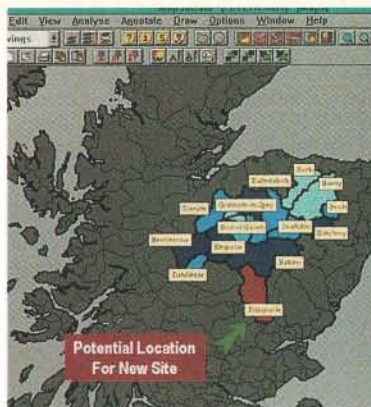
For more information on Microsoft's latest lists of CD+-compliant multisession CD-ROM drives for Windows, go to:

<http://www.eden.com/cdplus/index.html>.

Mac and PC users can view ActiveAudio releases at <http://quicktime.apple.com/qtmusic.html> and get additional information on the Track Zero specification at [http://quicktime.apple.com/AA\\_MENU.HTM](http://quicktime.apple.com/AA_MENU.HTM).



# BYTE EXTRA

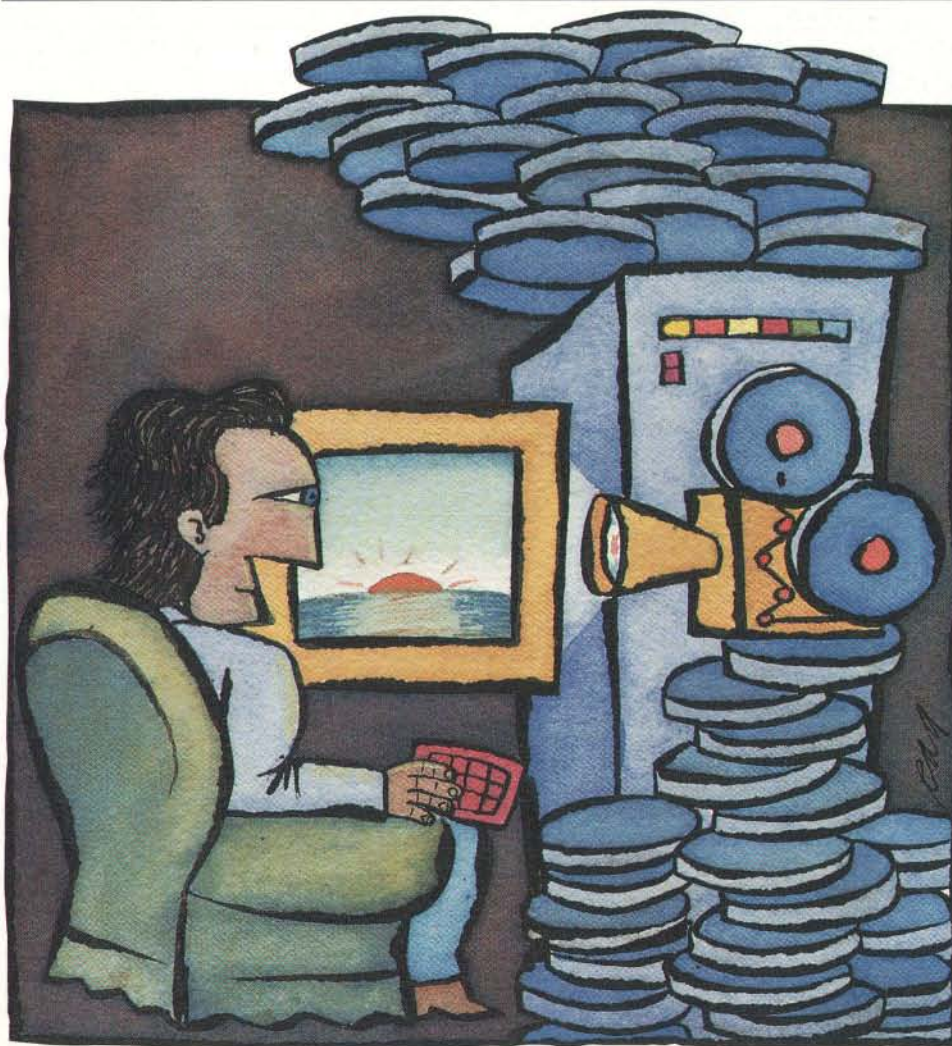


## Add Maps to Your Data

With Maps&Data for Windows you can give your business data a new dimension by displaying it on a wide range of maps.

page 32IS 20

# International Edition



## Turning On the Infobahn

How will we solve the serious technical challenges of bringing video on demand to every household?

◀ page 32IS 11

## CD-ROM and Erasable Disk

ImageStore combines a quad-speed CD-ROM and 650-MB erasable optical disk.

page 32IS 17



## PINK Web Manager

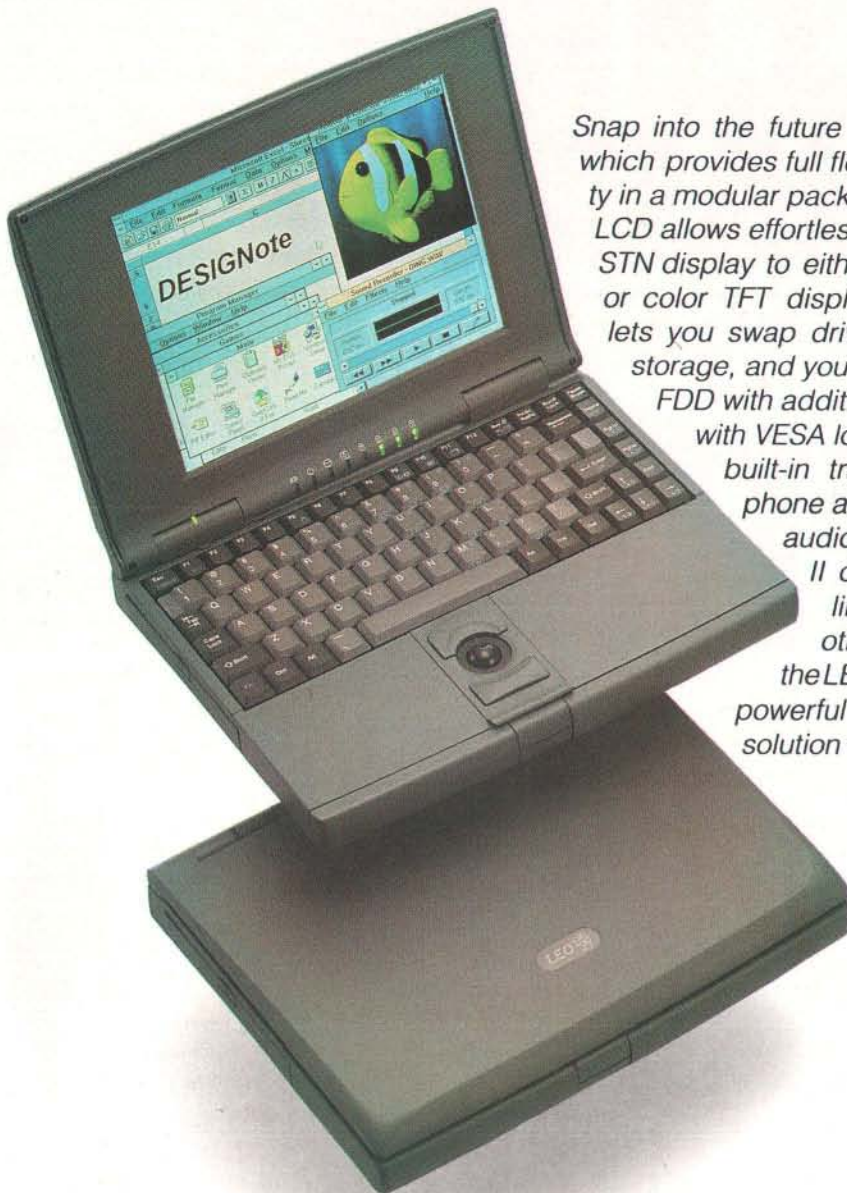
This shareware Macintosh editor lets you create HTML Web pages of text and images.

page 32IS 21





# THE SMART ALTERNATIVE..



Snap into the future with the LEO DESIGNNote which provides full flexibility and upgradeability in a modular package. The interchangeable LCD allows effortless upgrades from a mono STN display to either a color dual-scan STN or color TFT display. The removable HDD lets you swap drives with up to 500 MB of storage, and you can also replace the 3.5" FDD with additional modules. Intergrated with VESA local bus VGA Graphics, a built-in trackball, a built-in microphone and speaker for on-board audio, ports for PCMCIA type II or III, a choice from a full line of CPUs, and a host of other innovative features, the LEO DESIGNNote is the most powerful and versatile notebook solution around.



## ... LEO DESIGNNote

### Authorized Distributor:

BADER AL MULLA & BROTHERS CO.W.LL (KUWAIT)  
TEL:965-244-5040 FAX:965-243-7285  
AMERICAN TECHNOLOGIES, INC. (PHILIPPINES)  
TEL:63-2-774002 FAX:63-2-788629  
CENTERPRISE INTERNATIONAL LIMITED. (UK)  
TEL:44-256-463754 FAX:44-256-843174  
GOOD LUCK IMPORT EXPORT Co.,Ltd. (THAILAND)  
TEL:662-2132800 FAX:662-2125810

ICL INTERNATIONAL COMPUTER (SA) (PTY) LTD. (SA)  
TEL:27-11-3141023 FAX:27-11-314-2299  
JETDATA AB. (SWEDEN)  
TEL:46-8-960985 FAX:46-8-960069  
I.V. INDUSTRIE VERMITTLUNG & FINANZIERUNG, SPOL. S R. O.  
TEL:42-1998-2629 FAX:42-1998-2572  
NATION-TECH SDN.BHD. (MALAYSIA)  
TEL:60-3-9053878 FAX:60-3-9051357

WIRAINDO MULTISAKTI SETIAPUTRA.P.T.(INDONESIA)  
TEL:62-21-6256975 FAX:62-21-6010184  
AL READ AL ARABIA COMPUTER CORP. (JORDAN)  
(LEO MIDDLE EAST REPRESENTATIVE)  
TEL:962-6-683754 FAX:962-6-683754  
SEH COMPUTER-SYSTEME-VERTRIEBS GMBH. (GERMANY)  
TEL:49-6184-95010 FAX:49-6184-950188



6F, FORMOSA PLASTICS REAR BUILDING  
201, TUNG HWA NORTH ROAD,  
TAIPEI, TAIWAN  
Tel: 886-2-7174500 Fax: 886-2-7182782  
Telex 23056 Charlene

### First International Computer, Inc.

FIC EUROPE B.V.	Tel: 31-73-273300	Fax: 31-73-231412	FIC SPAIN	Tel: 34-1-6373502	Fax: 34-1-6373863
FIC USA	Tel: 1-510-2527777	Fax: 1-510-2528888	FIC HK	Tel: 852-2-3453599	Fax: 852-2-7972408
FIC AUSTRALIA	Tel: 61-2-7484566	Fax: 61-2-7484633	FIC CZECH	Tel: 42-5-41122643	Fax: 42-5-41213144
FIC JAPAN	Tel: 81-3-5461-2181	Fax: 81-3-5461-2345	FIC FRANCE	Tel: 33-1-46810203	Fax: 33-1-45739885

Specifications subject to change without notice. The Intel Inside logo is a trademark of Intel Corporation.

Circle 525 on Inquiry Card.



# Objects of Design

**RAINER MAUTH**

**W**hen a giant IT (information technology) user like Stuttgart's Mercedes-Benz reveals that it's adopting a new CAD/CAM system, the big question is, Why?

Mercedes-Benz, part of the Daimler-Benz high-tech trust, announced in March that it would switch to a new OO (object-oriented) CAD/CAM system by 1997, based on Computervision's Pelorus. Why? "We need a very flexible system to model our manufacturing and engineering processes," explained Dr. Wolfgang Renz, head of the CAD Competence Center at Mercedes-Benz. "It was clear that only an object-oriented system running on multiple operating systems could achieve this goal."

There's another major advantage to an OO CAD system: It's much easier to use—which translates into less time spent on the intensive training that sophisticated design programs require. As David Liddle discovered during his research at Xerox PARC (Palo Alto Research Center), a software package's usability comes primarily from how well the application maps to the user's view of the world.

A mechanical engineer designing a car has a world view that is much like the assembly procedure. He or she begins the design process with a mental outline; the engineer knows exactly what kind of entities are necessary to put the gear together. But when it comes to using a CAD system to make these ideas concrete, the engineer must translate a big part of his or her vision to lines, arcs, circles, and surfaces. This is how many engineers, architects, product designers, and plant builders have been working with programs like AutoCAD, Microstation, and CADDs over the past 10 years.

This mode of operation is going change as design programs take on OO characteristics. Although "object oriented" is often used as a marketing gimmick, in the case of CAD it will have profound effects.



**OO is changing the shape of CAD, making the software nearly as smart as the people who use it**

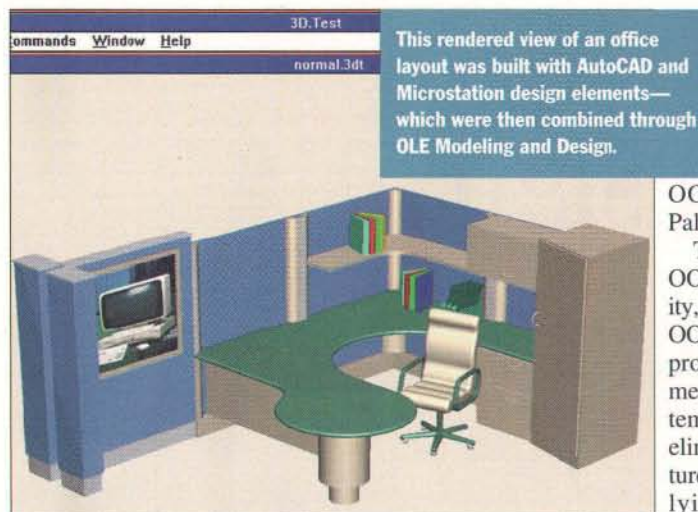
## What OO Means to a CAD User

To understand what object orientation means for a CAD operator, imagine an architect working on a building plan. He or she works with such entities as walls, windows, and doors. Using a flexible GUI-based CAAD (computer-aided architectural design) system, the architect is able to draw walls as multilines, automatically insert windows with optional height and width, and create doors

and other wall openings according to the measurements delivered by the client's supplier. He or she builds up the ground plan by putting prefabricated parts—or objects—together.

But what if the architect wanted to modify the first draft; for example, to move a window from one wall to another? A modern OO system lets a user simply click on the window and drag it to its new position. If it were a non-OO system, the user would have to delete every single element of the window, reshape the hole in the wall, and insert a new set of geometric elements representing the window into the other wall.





The architect's model of the world obviously consists of objects, such as walls, windows, doorways, stairways, and ceilings, behaving like objects of the real world, which means objects you can move without destroying. "Architects are creative people but not necessarily computer-literate. They expect CAD software to be intuitive and to feature intelligent objects with realistic behavior," says Thomas

of object orientation relate to each other.

"OOP is probably the best way to implement OO CAD features," says Thomas Weichsel, product manager with Ziegler Informatics, producer of the CADdy package. "In programming with C++, it is easier to design smart CAD objects, though it is not impossible to do it with procedural languages." Ziegler Informatics is currently evaluating the design of basic classes for

Bornhaupt, R&D manager of Acad-graph CAD Studio, developer of the OO CAD system Palladio.

To implement this OO CAD functionality, developers deploy OOP (object-oriented programming). That means the CAD systems offer OO modeling and design features due to an underlying OO program structure. Both terms

their new generation of CAD systems, called CADdy ++. Their first product in this line, CADdy ++ light, should be available now.

### Walls as C++ Classes

OOP is based on three principles: encapsulation, polymorphism, and inheritance. Encapsulation means binding data and code together so that the rest of the system sees an object that just has a certain behavior. Polymorphism means having objects that don't need to know anything about the internal mechanism of other objects they manipulate. Inheritance refers to a relationship between classes of objects that allows for grouping the objects in classes and subclasses that automatically inherit some of the classes' properties.

In the architectural example used earlier, OOP would mean that walls and windows are defined as basic C++ classes. The OOP principles give each instance of a class its own unique character and allow the defining of a hierarchy of classes that can effectively model the composition of design parts. The insert method—in OOP jargon, functions are called *methods*—could then be the same for all types of windows or walls. In the case of inserting,

# PEOPLE TALK ABOUT YOU

## THEY KNOW YOUR SECRETS

*But  
remember*



***It's nobody's business***

***But yours !***



→ **EliaShim.** We're here to help you PROTECT your work environment, SECURE and PRESERVE your data against calculated or accidental disasters, and CONTROL unauthorized access.

### Introducing **MasterSafe:**

A complete data access control, protection and management system package. Creates a completely closed secure environment, includes virus protection and central control of activities for PCs and LANs.

  
**EliaShim**  
Intelligent Computer Security

### Head Office: European Office:

EliaShim microcomputers Ltd. EliaShim Europe B.V. The Netherlands  
Tel: 972-4-516111 Tel: +31(0) 3402 54747  
Fax: 972-4-528613 Fax: +31(0) 3402 54867



# Catia/Cadam: Object-Implemented Engineering

Object-oriented design is having an influence where it's probably needed most—at the high end. The M-CAD (mechanical engineering CAD) system Catia/Cadam from Dassault Systemes (Paris)—used by industrial giants such as Boeing and IBM, to name just a few—has been based on object technology for several years. Dassault marketing director Etienne Droit describes the next wave as “object-implemented engineering in C++.”

The latest release, Version 4, features the first components (e.g., data management, user interface pieces, and a sketcher, among others) under this new architecture. Existing modules will quickly be moving to the new object architecture. Dassault's approach will provide a more flexible and scalable system con-

sisting of modules rather than a bunch of separate products.

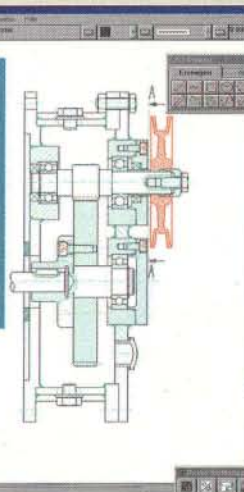
Version 4 features include symbolic associativity, controlled propagation, concurrent applications, knowledge-based product development, and hybrid modeling that lets you use multiple design methods—solid, surface, fillet, draft, sweep, and sewing—concurrently. Objects can be associated with rules and histories, and you can parameterize any part of your model any time in the design process.

Catia has recently been ported to HP-UX; announcements for SGHRX and Sun Solaris are expected shortly. ProCadum,

a sister product, will be available under Windows NT at the end of this year. Catia is based on a 3-D modeling kernel from Dassault; it's compliant with STEP and will be compliant with CORBA.

—Adele Hars

CADdy ++ light is the first member of Ziegler Informatics' object-oriented family. Aimed at 2-D mechanical design, it features flexible management of groups of design parts and symbols due to the object-oriented architecture.



both objects, window and wall, communicate through “messages” so that the wall knows to leave a space for the window. This kind of event-driven technology offers a well-structured, but nevertheless flexible, kind of application design. The use of operations on each design object can be controlled easily due to a limited set of object classes and a clear list of valid functions on the classes.

More complicated CAD objects, like roofs or arch bays, are a combination of several classes. “Many objects of our CAAD system relate to a conglomerate of basic classes,” says Thomas Bornhaupt. In Acadgraph's new OO Palladio program, the objects of the class of corner windows, for example, consist

of two standard windows instances connected through a geometrical constraint. “It does not make sense to represent the world just through basic classes. In many cases, it is more effective to combine them,” Bornhaupt says.



## CAD TALK

Some terms you should know when talking CAD:

**ACIS:** The ACIS (American Committee for Interoperable Systems) object-oriented 3-D geometry kernel has become a de facto standard in CAD/CAM. ACIS provides a rich set of solid, surface, and wireframe modeling functions, available as hierarchical C++ class libraries.

**Feature-based modeling:** In modern solid-modeling systems, design features are not necessarily geometric objects. They could also be frequently used functions like “insert a drillhole” or “extrude a plane.” OOP (object-oriented programming) enables this kind of equivalent treatment of functions and geometric objects, which helps make CAD more intuitive.

**Constraint management:** One speaks of constraint management or parametrics when a CAD model is not dimensionally fixed but rather is defined by a set of dimensions and geometric constraints. With constraint management, simply by modifying the numerical values of the constraints, it is easy to design a family of models with different dimensions.

**STEP:** The Standard for the Exchange of Product data was developed by CAD vendors, major automotive companies, and the ISO. There are local groups of the STEP committee in European countries, for example, ProSTEP in Germany. The goal of STEP is to define a standard for all product-related data over a whole life cycle. This includes an exchange format for CAD models.

### Plug In to OOP

Palladio 1.0 is a 3-D CAD solution for architects based on AutoCAD 13. According to Bornhaupt, one of Palladio's goals is to offer an intuitive tool for both rough and fast drafting studies and precise architectural design. The tool would be flexible enough to allow the user to work in different views that are related to the various states of an architectural project. Palladio users can “snoop” the identity of building parts. By touching an object with the cursor, you can instantly see its relation to other objects. For example, a line could identify itself as a center line or as perpendicular to another object.

There will be plenty of OO AutoCAD plug-in programs like Palladio coming from third-party developers during 1995. These plug-ins will be dedicated to architectural design, mechanical engineering and manufacturing, and mapping geographic data. The ground they are built on is the API of AutoCAD 13 (released last December).

The availability of specialized solutions on top of AutoCAD for all fields of applications has been one of the important



## OLE M&D: End of Data Exchange Hassles?

**A**s CAD and GIS (geographic information system) applications jump on the Windows desktop, there is an increasing need for seamless interchange of 2-D and 3-D models. OLE 2.0 allows for incorporating spreadsheets or simple graphics into a text document while they are still linked to the applications of origin. But this is not possible with a CAD system's complex 2-D vector graphics and 3-D objects.

OLE M&D (modeling and design) is a new OLE extension that enables OLE 2.0 to handle spatial arrangements and graphical objects. It is based on the COM (Component Object Model; see "COM: the Other Object Bus," April BYTE) that Intergraph Software Solutions designed. COM underlies all Microsoft object systems. A group of major CAD vendors including Autodesk, Bentley Systems, Intergraph, SDRC, and Spatial Technology have agreed to adopt it for their applications.

Data exchange between different CAD systems has been an annoying and complicated issue for many CAD users. Several file formats are used as an exchange standard, like DXF for 2-D drawings and IGES or the ACIS SAT format for 3-D models. But these formats don't guarantee flawless data exchange. However, STEP (Standard for the Exchange of Product data) does. There still is a lot of work to do in this area.

OLE M&D provides an open framework in which 3-D objects in different formats from different sources come together to form a unified model. OLE M&D allows users to combine objects from a variety of applications into a single document, without being concerned whether the applications understand each other's functionality or the internal data format.

According to Intergraph, each OLE M&D-compliant object maintains its position in space relative to others during linking or embedding. This new OLE concept will support transparent and translucent objects, which means that objects may be overlapped, superimposed, and displayed transparently.

Some of the first OLE M&D-compliant products on the market will be a sketch tool called Imagineer Technical, a machine design system (code named MD) from Intergraph, and an OLE M&D developer's kit. First customer shipments are expected by the end of this year.

Will OLE M&D be the end of CAD data exchange hassles? Probably not. Different CAD-using companies tend to employ different design layer structures in their models—and OLE will not consider these. Also, it is not yet clear how OLE will handle measurements or parametrics. Nevertheless, OLE M&D is a promising approach to seamless integration of 3-D data from different sources.

factors of AutoCAD's success. In Western European countries, where mechanical engineers have to deal with a lot of different standards for bolts and pins, and civil engineers are faced with detailed technical building regulations, these programs are popular. They offer extensive libraries of screws, seals, pumps, and boilers, and they support standardized hatching patterns. In Germany, for example, 80 percent of all AutoCAD copies are sold with a special-purpose plug-in.

AutoCAD 13 is based on the ACIS (American Committee for Interoperable Systems) solid-modeling kernel. It runs under DOS, Windows 3.1, and Windows NT and offers a new OO API called AutoCAD RX (Run-time Extension). AutoCAD RX contains a C++ class library and lets plug-in developers directly access AutoCAD's entity database to create "native" C++ objects and store them in the same database.

### OOD and Interoperability

The open access to defining and manipulating basic AutoCAD entities is a good way to make applications from different vendors interoperable. Interoperability is critical when members of a design project use different software packages. For example, an architect using one package passes a ground plan to a civil engineer who uses a different package to add sanitation facilities.

Autodesk and some of the AutoCAD add-in developers are currently working on how common basic classes of objects for every field of application should look. Once defined, each plug-in program can build its own objects out of common basic objects. So, C++ classes and the OO application design are becoming key to facilitating interoperability between applications.

Architectural design is expected to benefit most from an open framework of

## BW-European Distributors

### Austria

Computer Software Manufaktur  
Tel: +43 1 319 42 46, Fax: +43 1 317 30 40  
Network GmbH  
Tel: +43 160 69607, Fax: +43 160 69608

### Belgium

Comsol N.V.  
Tel: +32 24 610 170, Fax: +32 24 61 0130

### Czech Republic

Abakus Distribution A.S.  
+42 224 510 94  
+42 224 510 254

### Denmark

Sirius Data  
Tel: +45 32 962 010, Fax: +45 32 966 210

### Finland

Santa Monica S/W  
Tel: +358 0 692 3900  
Fax: +358 0 692 6107

### France

Fadimatec  
Tel: +33 1 49 460031  
Fax: +33 1 49 460258

### Germany

Tekelec Airtronic GmbH  
Tel: +49 89 516 40, Fax: +49 89 516 4110  
Megabyte EDV  
Tel: +49 89 741 1410  
Fax: +49 89 741 14144

### Hungary

Szki Comp. Comm. & Innov. Tech. Ltd.  
Tel: +36 12 018 122, Fax: +36 12 017 882

### Iceland

Netverk HF  
Tel: +354 1 61 6161, Fax: +354 1 15041

### Italy

ESA Software  
Tel: +39 541 74113, Fax: +39 541 742153  
Telena Data  
Tel: +39 25 82 00 1, Fax: +39 25 82 00248

### Netherlands

Radix  
Tel: +31 0 20 6 14 24 63, Fax: +31 0 20 615 9811  
T-Point Software B. V.  
Tel: +31 74 912 470, Fax: +31 74 437 937

### Norway

Scandinavian Comm Systems  
Tel: +47 22 658 180, Fax: +47 22 654 770

### Portugal

EFACEC, Gestão Informática S.A.  
Tel: +351 295 120 15, Fax: +351 295 18940

### Sweden

Microfront Vaxjo AB  
Tel: +44 862 68870, Fax: +44 862 67474

### Switzerland

Multicom Systems GmbH  
Tel: +41 17 011 110  
Fax: +41 17 011 128

### Turkey

SEKOM  
Tel: +90 312 468 23 73  
Fax: +90 312 468 23 80

### United Kingdom

Harrier Softnet  
Tel: +44 0734 731181, Fax: +44 0734 734546  
Systems Marketing Ltd.  
Tel: +44 0488 681004, Fax: +44 0488 681002  
UniDirect Ltd.  
Tel: +44 0788 52005, Fax: +44 0788 551129



# Your Golden Gateway to Windows 95. NEW BW-Connect NFS for DOS and Windows.



"Hey Fred, it says here you can get the Windows 95 version for free!"\*

Buy BW-Connect™ NFS v3.2 now and we'll upgrade you to the Windows 95™ version absolutely free! New version 3.2 includes the first commercial WWW server for Windows®, slick new Internet access tools, and over 40 Windows applications in all.

- Full suite of Winsock client tools including FTP, telnet, a threaded news client, gopher and much more.
- High performance NFS client.
- Quick and easy installation.

- Largest suite of Inetd-based server tools including FTP, telnet, lpd, gopher, bootp and many others.
- E-mail with MIME attachments, MAPI interface, 100,000 word spell checker.
- Supports DHCP client and BOOTP client and server for easy, centralized TCP/IP administration.
- Personal Internet Publishing with WWW and gopher servers.
- Factory direct!
- Low per user cost! (Substantial quantity discounts available).

BW-Connect NFS for DOS and Windows is your migration path to Windows 95. So get on the road to open connectivity today. Like Carl says, "When using the Web to cruise the Internet, it's a wide world out there."

**For your FREE 30-day personal evaluation just call or fax your distributor listed alongside this ad today.**

**Let's Connect!™**



**Beame & Whiteside Software™**

\*Provided user is under Beame & Whiteside Technical Support ("Support Services") contract at the time of the release. \*\*Developer tested only. Novell makes no warranties with respect to this product. All trademarks are the property of their respective owners. Beame & Whiteside Software, Inc. 706 Hillsborough St., Raleigh, NC 27603, Tel: (919) 831-8989, Fax: (919) 831-8990. ©1995 Beame & Whiteside Software, Inc. 156



geometric objects, because building plans consist of a finite set of repetitive parts. In M-CAD (mechanical engineering CAD), where the geometry is less repetitive, the conditions of interoperability are different. "OOP is an efficient way to make CAD systems smarter," says Udo Siegemund, managing director of Genius (which produces Genius 13), one of the leading vendors of AutoCAD M-CAD solutions in Europe. "Interoperability requires a more flexible mechanism to derive objects than that of AutoCAD 13."

#### Modeling Objects with ACIS

AutoCAD uses the ACIS modeling technology as a kernel for 3-D operations, which is a further example of the high impact object technology is having on CAD. ACIS is an open, OO geometric modeling toolkit for building 3-D applications; during the past two years, it has become a de facto standard. About 28 international software vendors are embedding or have embedded this geometry engine in their products, among them Bentley Systems, Hewlett-Packard, RoboCAD, and SDRC. It provides wireframe, surface, and solid modeling features that are based on B-reps (boundary representations). With ACIS, you create objects as a Boolean combination of wireframes, surfaces, and solids.

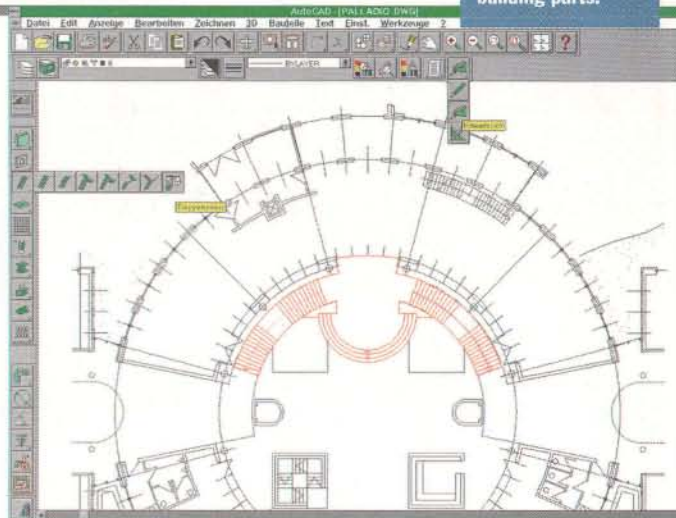
In a B-rep, a 3-D computer model is treated as if it were a real item; positions are determined as inside, outside, or on a boundary of a solid or surface. B-rep mod-

els need not necessarily be complete. They can have missing faces and edges, without the data structures being inconsistent. This ability to create so-called nonmanifold objects makes 3-D modeling very slick.

All ACIS attributes, geometries, and topologies are represented as a hierarchy of C++ classes that are subdivided into three



Acadgraph's Palladio is an object-oriented 3-D CAD solution for architects. It's based on AutoCAD 13. The program offers different views depending on the task at hand. At left is the modeling view, used for precise architectural design. Below is the sketch view, used for rough drafting studies. Users can "snoop" the identity of building parts.



## GODOT: A Prototype for Object Techniques in GIS

CAD models typically consist of vast amounts of geometric elements that are joined in a certain order, or hierarchy. These elements are frequently redesigned by the user. CAD systems, therefore, require a fast interactive graphics engine and complex data structures that can model the relationship of the design objects.

The same is valid for mapping systems and GISes (geographical information systems). The GODOT project at FAW (the Research Institute for Applied Knowledge Processing) at the University of Ulm (Germany) revealed how GIS can benefit from OOP (object-oriented programming). GODOT is a prototype GIS developed with C++ under OSF (Open Software Foundation) Motif. The project's goal was to incorporate object-oriented techniques into the storage and administration of complex

geographic and environmental information.

GODOT handles both graphical and non-graphical data in the same object-oriented database. It essentially uses three types of objects to model a real-world environment: geometries (regions, arcs, points), geo-objects (consisting of geometric elements), cartographics (used to represent geo-objects graphically). These objects communicate through messages.

Each object's identity allows different types of objects to be represented consistently throughout several database files. This universal object identification guarantees that even in distributed environments, each object maintains its identity. In an OODB (object-oriented database), a borderline between two areas can be modeled as a subclass of both areas. Whenever the borderline changes, both

areas are modified due to the subclass relation of the borderline. Therefore, all modifications are consistent. With this concept, it is possible to attach several graphical representations, for instance different scales, to every geographical object.

The OOP principles of inheritance, polymorphism, and encapsulation allow a flexible and versatile representation of geographical information. It is the easy maintenance and extension of geometric objects that makes OOP appropriate for GIS.

"GODOT shows that an OODB is an ideal candidate for the management of geometric, topographic, and nongraphical data in future GIS," says FAW's Günter Hess. According to Hess, GODOT's major problem is its performance when working with large amounts of data (more than 100 MB).



# The Hardlock software protection system.

## Universal and individual.

Across the world, there are currently over 1.5 million Hardlocks in use. They are all virtually hackproof, daisy-chainable, individually interchangeable, compatible, and with an almost incredible variety of forms and features, they are fast and easy to implement.

Want to know more? Want to find out which Hardlock will suit your application? Want to order the FREE Hardlock evaluation pack? No problem! Just dial...



**BeNeLux**, Crypsys Data Security, Tel: ++31-1830-24444, Fax: ++31-1830-22848 · **Croatia**, G&G Electronic, Tel: ++385-41-315794, Fax: ++385-41-333510 · **Finland**, FAST Finland Oy, Tel: ++358-0-5611001, Fax: ++358-0-5611006 · **France**, FAST Technologies, Tel: ++33-1-46211840, Fax: ++33-1-46210882 · **Great Britain**, FAST Electronic UK Ltd, Tel: ++44-1-71-2218024, Fax: ++44-1-71-7923449 · **Greece**, FAST Hellas AE, Tel: ++30-1-6854623, Fax: ++30-1-6854624 · **Hungary**, Recognita Corp., Tel: ++361-201-8925, Fax: ++361-201-7607 · **Iran**, SinaSoft Co. Ltd, Tel: ++98-21-622986, Fax: ++98-21-8865588 · **Italy**, Techne S.r.l., Tel: ++39-59-440690, Fax: ++39-59-440720 · **Spain/Portugal**, FAST Iberica S.L., Tel: ++34-1-7253626, Fax: ++34-1-7267219 · **USA/Canada/Far East**, Glenco Engineering Inc., Tel: ++1-708-808-0300, Fax: ++1-708-808-0313

Please contact FAST Electronic GmbH if your country is not listed.

Fast Electronic GmbH · Kaiser-Ludwig-Platz 5 · D-80336 Munich

Tel: ++49-89-53 98 00-20 · Fax: ++49-89-53 98 00-40

Circle 511 on Inquiry Card (RESELLERS: 512.)

**FAST**  
Fast Electronic GmbH



areas: attributes, geometry, and topology. The attributes class performs housekeeping and maintenance operations. The developer constructs specific attributes

color of one of the original parts. The geometry class describes the physical representation of the model (e.g., point, curve, sphere, and torus). The topology class refers to the spatial relations between geometric entities (e.g., body, face, loop, edge, and vertex).

ACIS is a powerful geometry engine that is flexible thanks to the OO approach. It is available for Windows, Windows NT, and all Unix platforms and is used primarily in mechanical engineering applications. Architectural CAD system developers

There are many examples of OOP influences on CAD technology. It's crucial that CAD systems support such object standards as CORBA, DCE, and OLE. Microsoft and Intergraph's approach to extend OLE to 3-D data (see the textbox "OLE M&D: End of Data Exchange Hassles?" on page 6) shows that smooth integration of CAD data is a big task for systems developers. As in the whole software industry, component technology is a major trend in CAD. Mercedes-Benz's Wolfgang Renz summarizes this as follows: "We want our software to work the way our manufacturing process works: modular and highly integrated."

Some people are skeptical about what they see as the industry's overblown hopes for OOP. While OOP hasn't yet had much influence on mundane applications, it is changing the shape of CAD. Just ask an engineer at Mercedes-Benz. ■

*Rainer Mauth is a BYTE senior editor based in the Frankfurt, Germany, bureau. Before coming to BYTE, he worked for a CAD magazine. You can reach him on the Internet or BIX at [rmauth@bix.com](mailto:rmauth@bix.com) or on CompuServe at 75372,3464.*

## Product Information

### CADdy++ light . . . . . DM 998

Ziegler Informatics  
Mönchengladbach, Germany  
+49 2166 955 56  
fax: +49 2166 955 600  
Circle 1316 on Inquiry Card.

### Genius 13 . . . about DM 6000

Genius  
Amberg, Germany  
+49 9621 76650  
fax: +49 9621 766533  
Circle 1317 on Inquiry Card.

### GODOT

FAW  
Ulm, Germany  
+49 731 501 416  
fax: +49 731 501 999  
Circle 1318 on Inquiry Card.

### OLE M&D, Microstation

Intergraph  
Ismaning, Germany  
+49 89 96106 0  
fax: +49 89 96106 100  
Circle 1319 on Inquiry Card.

### Palladio . . . . . call for price

Acadgraph  
Munich, Germany  
+49 89 6423040  
fax: +49 89 647343  
Circle 1320 on Inquiry Card.

### Pelorus

Computervision  
Wiesbaden, Germany  
+49 611 2750  
fax: +49 611 275 275  
Circle 1321 on Inquiry Card.

defining new classes based on the generic attribute class. This system of attributes allows a developer to handle the properties of combined objects very efficiently. For example, the definition of the color of two merged bodies via a hierarchy of attributes can easily be defined as the

have reservations about ACIS because, for the relatively small solids that architects typically deal with, ACIS generates files that are too big. But in mechanical engineering, in which Boolean operations of large models are common, ACIS offers excellent performance.

# LabVIEW®

## Proven Productivity for Your Industry

### Software Innovation – for Your Applications

LabVIEW gives you the software to automate your measurement, control, and analysis applications. LabVIEW pioneered Virtual Instrumentation almost a decade ago and continues to deliver proven productivity.

### Flexible I/O – for Your Instrumentation

LabVIEW communicates with thousands of I/O devices, including our complete line of data acquisition hardware, GPIB and VXI instruments, serial devices, PLCs, and much more.

### Solutions Worldwide – for Your Industry

Today, LabVIEW is making a difference in many industries, including automotive, telecommunications, semiconductor, electronics, aerospace, chemical, and education.

If you want to learn more about LabVIEW, give us a call. We'll show you how you can benefit from the graphical programming power of LabVIEW – **It's Proven Productivity for Your Industry.**



Call today for  
**FREE LabVIEW**  
software demo

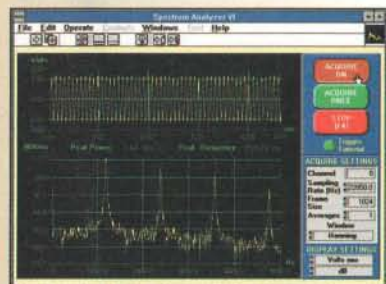


Branch Offices: Australia 03 9 879 9422 • Austria 0662 45 79 90 0 • Belgium 02 757 00 20  
Canada 519 622 9310 • Denmark 45 76 26 00 • Finland 90 527 2321 • France 1 48 14 24 24  
Germany 089 741 31 30 • Hong Kong 2645 3186 • Italy 02 48301892 • Japan 03 5472 2970  
Korea 02 596 7456 • Mexico 5 202 2544 • Netherlands 03480 33466 • Norway 32 84 84 00  
Singapore 2265886 • Spain 91 640 0085 • Sweden 08 730 49 70 • Switzerland 056 20 51 51  
Taiwan 02 377 1200 • U.K. 01635 523545

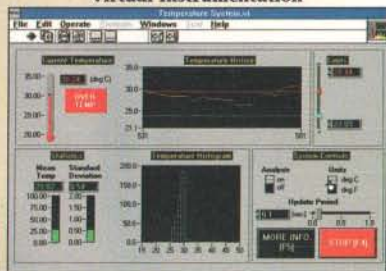
### U.S. Corporate Headquarters

Tel: (512) 794-0100 • Fax: (512) 794-8411 • E-mail: [info@natinst.com](mailto:info@natinst.com) • WWW: <http://www.natinst.com>

© Copyright 1995 National Instruments Corporation. All rights reserved. Product and company names listed are trademarks or trade names of their respective companies.



Virtual Instrumentation



Process Monitoring and Control



Test and Measurement



# Turning On the Infobahn

DICK POUNTAIN

If you think the information superhighway is overcrowded now, just wait until the multitudes start turning on VoD (video-on-demand). It's this service that will tempt most newcomers onto the Infobahn, as they look for their favorite movies and TV programs to watch when they want, with such VCR-like capabilities as rewind, pause, and fast forward. And we're not talking about the distant future—super servers that enable VoD are already here.

With VoD, a user will select a program from an on-screen menu, and it will start playing, automatically charging its rental cost to his or her account via an STB (set-top box) similar to those that cable and satellite pay-TV systems currently use. This is not the same as downloading a movie over a network; with VoD, the user receives a real-time video feed that starts within seconds, just as with conventional cable TV. VoD is a client/server system—the movie that you choose is stored as compressed digital data on a remote VoD server, and pressing the selection button on your remote control sends a signal back to the server to connect to it.

VoD differs from ordinary network, cable, or satellite TV in that you may be the only person viewing that movie at that particular time—even if several other viewers have requested it, you're probably all watching it at different stages. VoD's offer to send programs to subscribers whenever they want them has staggering implications in terms of bandwidth requirements.

Today's broadcast TV is of course analog, but it would require a digital stream of around 140 Mbps to transmit equivalent picture quality. Of course, that 140-Mbps data stream can serve the whole population of a country the size of the U.K., running into tens of millions of people.

Digital VoD systems require a separate channel for each customer. They employ MPEG data compression to reduce the data rate needed to transmit a video stream of somewhat lower than broadcast quality to between 1.4 and 2 Mbps. However, they need to

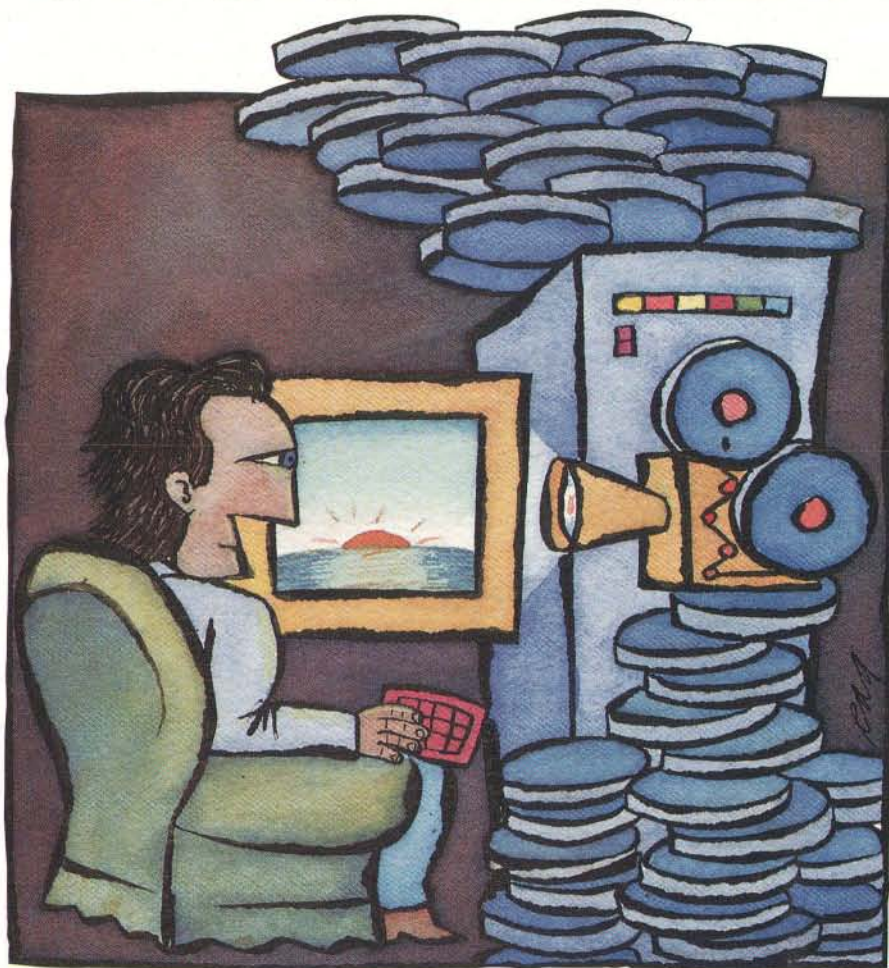
## Bringing video on demand to every household presents some serious technical challenges

sustain that rate to each connected TV set, so a VoD server for a small town of 20,000 people would have to supply about 30 Gbps if everyone wanted to watch at the same time, or 8 Gbps at a more realistic 25 percent usage. And this has to be reliable, real-time bandwidth, since no one's going to watch programs that have unscheduled gaps and pauses in transmission.

### Huge Amounts of Data

The data volumes required for VoD systems are just as impressive as the data rates. An MPEG-compressed 90-minute movie occupies 1 GB or more of storage, so to provide a reasonably comprehensive movie library of a thousand titles, you'd need at least a TB of mass storage.

Pundits of the information superhighway foresee a time in which all TV programs, including news and other topical information, will be provided as on-demand services. The amount of storage that would be required for such a system on a national or



RICHARD A. GOLDBERG © 1995



# Today's VoD Servers

## ICL PimServer

The PimServer from ICL is a modified version of the firm's Goldrush parallel database server architecture. It's built from processor modules, each of which is a complete multimedia computer containing twin 66-MHz HyperSparc RISC processors, 256 MB of memory, two Fast Wide SCSI disk controllers, a 155-Mbps ATM/STM-1 port, and a 20-Mbps connection to ICL's Deltanet switched interconnect.

Each module can handle about 60 video sessions. Deltanet is based on fast 8 by 8 crossbar switch chips; in a fully populated machine the switching network has a total bandwidth of 1.2 Gbps. The PimServer runs a distributed version of Unix SVR 4.0 built on the Chorus microkernel, which provides a lightweight real-time communications service layer (see "The Chorus Microkernel," January 1994 BYTE). A fully populated PimServer can hold 32 processing elements with up to 1500 GB of disk storage, enabling it to service up to 2000 simultaneous video sessions.

## Siemens Nixdorf RM1000

Siemens Nixdorf Informationssysteme produces a modular multimedia server system. SNI's RM400 and RM600 models are SMP (symmetric multiprocessing) machines based on the 64-bit MIPS R4400 RISC processor on Intel's PCI (Peripheral Component Interconnect) bus, with the number of CPUs per box ranging from one in a basic RM400 to 24 in a fully configured RM600. A single RM400 can store 100



A modular Siemens Nixdorf CPU with dual R4400s.

serve up to 80 sessions, but to build higher specification VoD servers, you can cluster RM400s and RM600s using the RM1000 system architecture that SNI bought from the U.S. firm Pyramid. RM1000 employs a high-speed, scalable switched interconnect to join any mixture of single CPU nodes, RM series SMP boxes, or Pyramid's own Nile series computers into a distributed MPP (massively parallel processing) system with up to hundreds of CPUs. SNI supplies a Unix-based software system whose functions include video file service, video stream management, video request handling, video object service, and network access.

## Meiko CS-2

Meiko specializes in building MPP supercomputer systems and plans to offer VoD servers based on its modular CS-2 architecture. The CS-2 is built from nodes containing SuperSparc processors and twin SCSI-2 disk controllers, and memory. These nodes are connected via a multilayer switched network built from Meiko's own ASIC chips Elan and Elite: Elan moves packets between Sun's Mbus and Meiko's 100-Mbps serial interprocessor links, while Elite

is an 8 by 8 crossbar switch. To provide 7000 customers (say 25 percent of a town of 28,000) with 500 videos, Meiko reckons that a CS-2 server would require about 60 processor elements devoted to ATM packet creation, and 100 elements devoted to video pump duties, each connected to 5 GB of RAID. These figures include a margin of



PimServer from ICL

redundancy for fault-tolerant operation. In addition to its video pumps and ATM engines, such a configuration would contain 10 more processors handling incoming requests from customers' STBs (set-top boxes) and another 10 for administration, database, and billing tasks, making a total of 180 CPUs. The CS-2 runs Sun's Solaris version of Unix with Meiko's proprietary distribution layer providing IPC (interprocess communications).

## Concurrent Computer Maxion/IMS

Concurrent Computer's Maxion/IMS (Interactive Multimedia Server) is a packaged multiprocessor system aimed at medium-scale VoD, videoconferencing, telemedicine, and similar interactive applications. Like SNI's RM series, it's based on the Mips R4400 CPU, but it is a distributed memory system. Concurrent's UltraSmart architecture consists of six ports, each capable of a 400-Mbps peak, and a fast crosspoint switch that can connect any of them to provide a total internal bandwidth of 1.2 Gbps. Four of the ports can be fitted with processor/memory cards, each holding a 200-MHz R4400 and up to 128 MB of ECC (error-correction code) protected memory, while the other two are fitted with 64-bit VME buses.

transnational basis almost defies the imagination.

In field trials, potential VoD vendors are turning to off-the-shelf computer systems for their VoD servers. The shelf that these systems come off is pretty high. MPP (massively parallel processing) computers are needed to even get close to the performance requirements for a VoD server, and the VoD market's potential may provide a lifeline for hard-pressed supercomputer vendors. The past few years have not been kind to the parallel-processing sector due to the combined effects of recession, defense cuts, saturation of the supercomputer market, and the continuing lack of portable parallel software—the roll

call of the fallen includes such famous names as Thinking Machines and Cray Computer. Many of the surviving MPP vendors now have VoD products either ready for market or in advanced planning.

There is no full-scale commercial VoD system in operation yet. In the U.S., Oracle has been pursuing extensive VoD trials with parallel computer vendor nCube, while a consortium including Acorn Computers and ICL is currently running a trial in the U.K. city of Cambridge. There are also field trials in such European countries as Germany and France.

In addition to testing the economics of a new VoD system and the best way to market it, such trials are crucial for discover-

ing how real VoD customers will behave, which will determine the performance required from the hardware. For example, if viewers make extensive use of the rewind and pause facilities, this can reduce the number of users that a single processor can service by a factor of 3 or more; the freeze-frame option in particular can tie up large amounts of server memory.

Miles Chesney, research chief of parallel computer manufacturer Meiko, says the problem is similar to that of building a new motorway: Only after it's built can you determine exact usage patterns. "For VoD, we need to use trials and simulations to discover [how the systems are used] in advance."



# Ergonomic Furniture for every Computerized Work Environment



## ORGANIZE COMPUTER EQUIPMENT

Ergotron LAN Furniture organizes monitors, servers and other equipment upward into previously unused "free" air space. For existing equipment, this immediately reduces floor space requirements. As your LAN grows, Ergotron can help you potentially triple or even quadruple available floor space without costly building expansion.

## IMPROVE COMPUTER ACCESS

With the flexibility of Ergotron's open architecture, you can custom-configure standard components to organize equipment, improve computer access and reduce system downtime. The unique Cable Management System not only hides cables, but organizes them for easy access and identification.

## ERGONOMIC ADJUSTABILITY

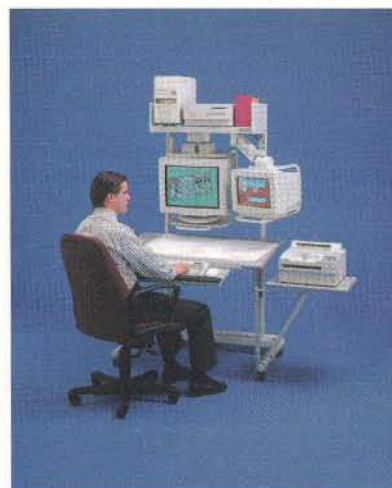
And with Ergotron's patented monitor suspension, you can lift, glide, tilt, swing, and rotate every monitor until they're "just right" for easy access and comfortable viewing.

Tested at over 900kg, Ergotron systems are ruggedly built to protect your computer investment and last a lifetime.

For more information and a free brochure, contact our European sales office:

Ergotron Europe  
Karspeldreef 19.1102 BB  
AMSTERDAM  
The Netherlands

Tel: +31 20 696.60.65  
Fax: +31 20 609.04.59



**ERGOTRON** EUROPE  
Ergonomic Computer WorkCenters



# COMPUTER Quick

## Multimedia

SoundBlaster 32 AWE Value Edition ... 235  
Macromedia Director Studio ... 1375  
Proxima Ovation 820 Active Matrix ... 4340  
Radius VideoVision Studio ... 3790  
RealMagic MPEG Producer ... 3600  
Turtle Beach Multisound Monterey ... 335  
TrueVision Torch 2000 EISA ... 4400

## Backup

Colorado 700 MB Internal ... 275  
Exabyte 4200C 4GB Int/Ext ... 940/1105  
Exabyte 8505 8MM 10GB Tape Int ... 2099  
HP DAT 3.5" 24/8-16GB ... 825/940/1160  
WangDat 3.5" DAT ... 868  
WangDat 4/8" DAT ... 1057

## CAD

Autodesk 3D Studio Rel 4 ... CALL  
Calcomp 12x12 Cordless ... 295  
Calcomp 12x18 Cordless ... 600  
Calcomp CM Thermal A-8 Size ... 6715  
Calcomp DM A-D Size 1MB 8Pin ... 2250  
Numonic AccuGrid 20x24 ... 1525  
SummaSketch III 12x12 ... 334  
SummaSketch MicroGrid III 44x60 ... 2970

## Chips

All Upgrades - AST, Apple,  
Compaq, DEC, HP, IBM  
Silicon Graphics, SUN, Toshiba

CPU (Intel, Cxix, AMD-DX2, DX4)  
SIMM - ALL CONFIGURATIONS ... CALL

## Hard Drives

CALL for today's price!

Conner/Maxtor 540MB IDE ... 180  
Conner/Quantum 1GB SCSI ... 370  
Conner 1.2GB IDE 3.5" ... 260  
Conner 2.1 GB SCSI 3.5" ... 710  
Micropolis 1.6GB AV 3.5" IDE ... 600  
Micropolis 9GB SCSI 5.25" ... 2500  
Seagate 2.1GB Barracuda ... 1045  
Seagate 5150N 4.2GB SCSI ... 1655

## Computers

**pentium™**  
PROCESSOR

DEC ALPHA PC 150MHz 17" Monit ... 7308  
ALR Revol Q-SMP EISA 100MHz ... 6625  
ALR Revol PCI/EISA 100MHz ... 4565  
Intel MB Pentium-4MB EDO Mem ... 645  
AIR Dual Pentium MB EISA/PCI ... 810

## Controllers

Adaptec 2742WK Wide EISA Kit ... 389  
Adaptec 1542CF Kit ... 265  
Adaptec 2742A EISA SCSI ... 327  
Adaptec 2842C VLB SCSI ... 296  
Biosonic KT946C SCSI PCI Kit ... 295  
OLogic FastSCSI PCI ... 205  
OLogic FastSCSI EISA/PCI ... 204

## Graphics Cards

ATI Gr Ultra Pro TURBO 4MB VLB/PCI 501  
Diam Video Star Pro ... 495  
Diam Stealth 64 4MB VLB/PCI ... 472  
Diam Viper 2MB VLB/PCI ... 314/330  
Matrox MGA Impres Pro 8.5MB ... 1425  
Matrox MGA Impres+ 2MB PCI/VLB ... 375  
Number 9 Image 128 Bit 4MB PCI ... 875  
Number 9 GXE 64 Pro 64M PCI ... 698  
Number 9 771 Motion 4MB PCI ... 450  
Orchid Katwin 2 MB 64-bit VLB ... 224

- Quantity Discounts
- Dealer Discounts

PHONE: (415) 861-8330

Español: (415) 861-8376

FAX: (415) 861-8380

E-Mail - CQK@AOL.COM

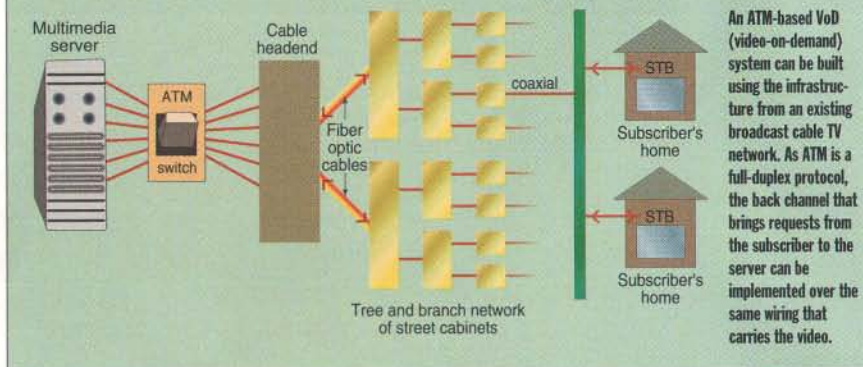
WWW.CQK.COM

Low freight rates • No handling charge • Prices are for cash prepayment • VISA/MC/AMEX accepted • Products may be USA versions • No returns on opened software • Prices are FOB USA & subject to change • 15% restocking charge for non-defective returns

Computer Quick, 165 - 8th Street, No. 309  
San Francisco, CA 94103, USA

Circle 505 on Inquiry Card.

## An ATM-based VoD System



An ATM-based VoD (video-on-demand) system can be built using the infrastructure from an existing broadcast cable TV network. As ATM is a full-duplex protocol, the back channel that brings requests from the subscriber to the server can be implemented over the same wiring that carries the video.

The requirements for a VoD server look much like those for a large multiprocessor database server, namely large numbers of disk drives to hold the data, and multiple processors to retrieve this data quickly and dispatch it to multiple simultaneous clients. However, because the outputs are video streams rather than discrete transactions, the real-time capabilities of VoD servers are most important.

Video is stored on the server's hard disk drives in MPEG-compressed form. MPEG 2 will likely be the standard by the time commercial systems are deployed. The video remains compressed during transmission until a single-chip MPEG decoder inside the customer's STB decompresses it.

The STB also handles decryption and user interaction via a remote control unit, and it may also contain a microprocessor and memory to allow games or other client software to be run locally.

The choice of a network medium over which to transmit video to VoD subscribers is a crucial issue. The ideal situation would be to run fiber-optic cable into every customer's home, enabling the use of a fast switched ATM (asynchronous transfer mode) network to convey video and other

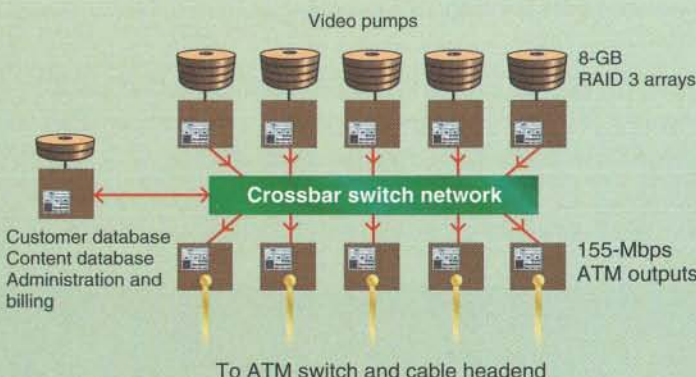
services (see "ATM Traffic Control," December 1994 BYTE). ATM offers many advantages, not the least of which is its scalable bandwidth that allows the same basic packet-switched transmission protocol to be used over the 622-Mbps trunk routes between servers as is used over the 2-Mbps lines into customers' homes.

## Running the Wires

Unfortunately, the cost of recabling everyone with fiber is too much for most telecommunication companies to swallow, unless they can get entertainment licenses and take a slice of any VoD profits; in the U.K., this is the source of a bitter dispute that's arisen between British Telecom and the government.

An alternative is the coaxial cable used by current cable TV systems, which can support BISDN (Broadband ISDN) channels—the Cambridge trial is using special hybrid fiber-coaxial switches to run ATM over such cable for the first time. But for much of the world, the local telephone company's copper wire is the only available medium, and sending video streams over such wire presents a severe technical challenge. The solution, called ADSL

## Generic VoD architecture



A generic VoD (video-on-demand) server architecture based on multiple processing and disk storage nodes with a switched point-to-point interconnect network. Each ATM output can support as many as 60 to 80 separate video sessions.

To ATM switch and cable headend



## How Usage Patterns Determine System Design

Several field trials suggest that, on average, 20 percent of VoD (video-on-demand) customers will be watching the most popular video and that 80 percent of them will be watching the 50 most popular videos. Hence, it would be wasteful to apportion the available bandwidth evenly between all videos in a library. Instead, the top 10 most popular videos will need to be entirely cached in RAM most of the time, with hundreds of

viewers connected to each cache, while other less-popular videos will be paged in from disk as required. It's the task of the operating software, which is invariably based on some flavor of Unix with real-time and distributed IPC (interprocess communications) extensions, to ensure that an efficient caching pattern is maintained.

Large VoD libraries will probably need to add a third level to this storage hierarchy,

keeping the least-requested movies in an automated tape bank or an optical disk jukebox. When one of these is requested, it will have to be loaded onto a hard disk (displacing an older one) before viewing, which would result in a wait of several minutes rather than the normal 10 to 15 seconds. However, the system could be designed to conceal this latency by running it concurrently with advertisements, short cartoons, or other program material.

(Asymmetric Digital Subscriber Loop) involves sophisticated signal-processing techniques and is good only for distances of 5 kilometers or less, but it works and is likely to be the preferred interim technology in many areas.

Nevertheless, ATM is clearly the most likely future solution (see the figure "An ATM-based VoD System" on page 14). Video streams pass from the server into an ATM switch that routes them toward the subscribers that requested them. Along the way, switches contained in district- and street-level roadside cabinets progressively split the video stream into many slower streams, in a tree-and-branch fashion, until they finally emerge as hundreds or thousands of 2-Mbps streams over coaxial or copper cable into customers' homes.

In effect, a typical high-end VoD server (see the figure "Generic VoD Architecture" on page 14) consists of an array of ATM output ports and a vast array of disk drives that hold the videos. The technical challenge is to get the data from the right disks to the right output ports and keep it coming fast enough to sustain continuous video streams. Hence, internal bandwidth becomes a most important factor for VoD servers, and this rules out the simple shared-memory SMP (symmetric multiprocessing) architectures that are being used for LAN file servers running Windows NT or Unix. However many processors you add, the shared system bus of an SMP machine becomes a bottleneck.

Most contenders for large-scale VoD systems therefore tend to employ distributed-memory message-passing architectures with switched IPC (interprocess communications) networks in place of a shared system bus. Such a network is built from some kind of point-to-point communications link (parallel or serial) with a typical bandwidth of several hundred Mbps, together with crossbar switches that can connect any processor to any other to allow data to move between their memory spaces. Because the links are point-to-point, they can all run simultaneously without contention, and so the total bandwidth is simply

Call for a free  
copy of  
**Velocis!**



## Diving into C++ Database Development Without Velocis Can Be Pretty Ugly.

**Velocis™** database server is a scalable high performance, client/server database engine that supports ANSI SQL, ODBC, C, and C++. Built to support complex database designs, Velocis provides powerful transaction processing features, low-level access, and portability. With multiple APIs, you have the power to build winning applications that can access the server from heterogeneous clients.

**Raima Object Manager™** is a class library that encapsulates object storage and database navigation into C++ class definitions to provide a consistent, object-oriented interface to Velocis.

Combined, Raima Object Manager and Velocis provide the most comprehensive feature set available for your C++ database development.

# RAIMA™

Call: 1-206-557-0200 Fax: 206-557-5200

Available for: Windows, Windows NT, OS/2, SCO, AIX, HP/UX, Solaris, Netware, and others.

Raima Corporation, 1605 NW Sammamish Rd., Issaquah, WA 98027, Inside the US: 1-800-275-4724, Internet: sales@raima.com  
Germany: 49 7022 9256 0 Spain: 3 43 485 13 04 Italy: 39 49 80 7 7 140 Argentina: 54 1 954 1414 Raima UK Ltd.: 44 1 273 819 292  
France: 33 1 30 67 29 63 Australia: 61 2 419 7177 Raima Benelux: 31 2159 44 738 Denmark: 45 44 88 99 00  
Taiwan: 886 2 503 3006 Finland: 358 0 8045 130 Norway: 47 22 110 950 Sweden: 46 13 111 588



the sum of all the active links.

A typical VoD server is built from modules that contain CPUs, memory, disk I/O, ATM outputs, and IPC, so that adding more modules increases not just the memory and processing power but also the external and internal communications bandwidth proportionately. This makes such systems inherently more scalable than SMP systems, in which bus bandwidth doesn't increase as you add more CPUs.

Exactly how the functions divide up between modules varies from manufac-

turer to manufacturer. Concurrent Computer's Maxion treats CPU, memory, and I/O as separate modules, whereas in ICL's PimServer, each module has its own CPU, memory, disks, and ATM port. The text box "Today's VoD Servers" on page 12 describes VoD servers currently available or coming soon.

The storage for large VoD servers is typically built from RAID's of commodity hard disks with typical capacities of about 8 GB per module. Often RAID level 3 is required to provide a degree of fault tol-

# Build Your Own TCP/IP Applications

## with Distinct TCP/IP DLLs and Custom Controls (VBXs)

SOFTWARE DEVELOPMENT HUBS  
**Visual Edition**

- TCP/IP Custom Controls for Windows Sockets, SLIP/PPP, Telnet, VT220, FTP, RCP, R-commands (remote shell, rlogin and rexec), Mail (SMTP, POP2/POP3) and News (NNTP). For Visual Basic users only.

- Just define properties and handle events, no DLLs to call or TSR to use.

- 12 sample applications and over 300 pages of documentation included.

- Includes Distinct's small and fast Windows Sockets protocol stack; extensions run over other Windows Sockets compliant stacks.

SOFTWARE DEVELOPMENT HUBS  
**Professional Edition**

- Includes all the features of the Standard Edition PLUS Telnet VT emulator, drag and drop FTP client and server, TFTP, LPR, LPD, transparent printing, Network Monitor, Finger and more.

SOFTWARE DEVELOPMENT HUBS  
**Standard Edition**

- APIs for Windows Sockets, Berkeley Sockets, ONC RPC/XDR, Telnet, FTP, SMTP, POP2/POP3, NNTP and NetWin.

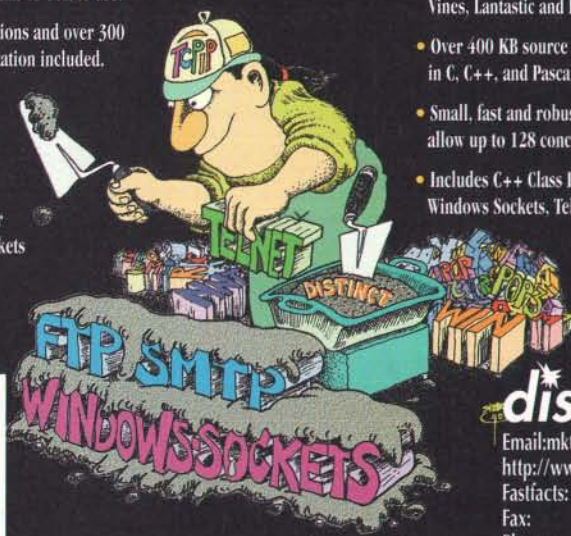
- Supports NDIS, ODI or Packet drivers, SLIP, CSLIP and PPP with scripting.

- Co-exists with Windows for Workgroups, Netware, Lan Manager, Vines, Lantastic and Pathworks.

- Over 400 KB source code samples in C, C++, and Pascal.

- Small, fast and robust 100% DLLs, allow up to 128 concurrent sessions.

- Includes C++ Class Libraries for Windows Sockets, Telnet and FTP.



**distinct**

Email: mktg@distinct.com  
http://www.distinct.com  
Fastfacts: 408.366.2101  
Fax: 408.366.0153  
Phone: 408.366.8933

### Product Information

#### PimServer

ICL  
High Performance Systems Division  
Manchester, U.K.  
+44 161 223 1301  
fax: +44 161 223 0482  
**Circle 1312 on Inquiry Card.**

#### CS-2

Meiko, Ltd.  
Bristol, U.K.  
+44 1454 616171  
fax: +44 1454 618188  
**Circle 1313 on Inquiry Card.**

#### RM1000

Siemens Nixdorf Informationssysteme AG  
Midrange Systems  
Paderborn, Germany  
+49 5251 815350  
fax: +49 5251 815353  
**Circle 1314 on Inquiry Card.**

#### Maxion/IMS

Concurrent Computer Corp.  
Berkshire, U.K.  
+44 1753 513266  
fax: +44 1753 513248  
**Circle 1315 on Inquiry Card.**

erance, and multiple copies of each movie are stored for the same reason. Each such RAID, connected by a 20-Mbps Fast Wide SCSI to a local memory cache and a CPU, constitutes a "video pump." With efficient caching, each pump could serve from 50 to 80 users, depending on how much they made use of the pause and forward/rewind features.

Another set of CPUs must be devoted to the chore of protocol processing (i.e., chopping up the video streams into ATM packets). The internal switching network connects each output to the appropriate video pump and provides a total cross-sectional bandwidth of several GBps. Each ATM output module should be capable of supporting up to 100 simultaneous customers. But exactly how many of the RAID arrays will be required to support that rate depends on customers' usage patterns (see the text box "How Usage Patterns Determine System Design" on page 15).

It should come as no surprise that such machines aren't cheap; prices reach into the millions of dollars. Of course, the really significant index is the price per subscriber. Meiko mentions a target figure of \$150 per subscriber over the lifetime of the machine in a population of 120,000, extrapolating from the cost of the largest parallel supercomputer it has installed to date. The fact remains that no one has yet tried to provide VoD to tens of thousands of users, and the technical problems of serving even more subscribers have yet to be explored. But that day is fast approaching. ■

*Dick Pountain is a BYTE contributing editor based in London, U.K. You can reach him on the Internet or BIX at dickp@bix.com.*



# WHAT'S NEW Hardware

## VOBIS' HIGH-END ► SYSTEM

Vobis' SkyTower 500 ZE-133 PCI features a 133-MHz Pentium processor with a PCI bus. The basic configuration contains 8 MB of EDO-RAM and ships with Windows 95 and OS/2 Warp. Each machine includes either Microsoft Word for Windows, Excel, or Access.

**Price:** starts at DM 6000.

**Contact:** Vobis Microcomputer A.G.  
Würselen bei Aachen, Germany  
+49 02405 4440 500  
fax: +49 02405 444 505.

**Circle 1329 on Inquiry Card.**



## WATCH YOUR PHONE BILL

The Eltel phone manager registers all incoming and outbound calls and saves the data to a PC. Eltel records the date, time, duration, phone number, and charges of up to 2000 phone calls; even incomplete calls are registered. Eltel lets you separate business, international, and personal calls as well as retrieve specific numbers. Eltel's customized reporting function lets you evaluate, for example, the efficiency of your telephone marketing crew.

**Price:** 395 SFr.  
**Contact:** Eurolink Wetzikon, Switzerland  
+41 1 970 1212  
fax: +41 1 930 3188.

**Circle 1323 on Inquiry Card.**

## EXPANDED UPS PROTECTION

LanQuattro is a communications device for UPSes (uninterruptible power supplies). It can talk simultaneously to four independent computers and provides four output ports that you can connect to the serial port of a UPS. ◀ You can decide which of the four devices might change the parameters of the UPS or send "power down/up" commands.  
**Price:** \$690 (without software).  
**Contact:** Fiskars Power Systems



*Espoo, Finland*  
+358 04526 6281  
fax: +358 04526 6396.  
**Circle 1321 on Inquiry Card.**

## TELEWORKERS CAN RELAX WITH RELACS ▼

Incaa Datacom has launched RELACS, a modular access control system for the remote workforce. Each RELACS base unit contains up to four workstations, each with integrated dial-in security, a screen, a keyboard, and a switching controller. Multiple base units can be linked together and managed from one central position, and they can back each other up. If a workstation or modem drops out, the next authorized caller is automatically connected to a freshly reset workstation. A special "antihang" cir-

cuit ensures that authorized users can always obtain access, regardless of the state of the workstation. RELACS gives users two choices of dial-in security: standard password protection with an optional call-back feature and a challenge/response-based system with facilities for personal identification and encryption. RELACS supports NetWare, DOS, OS/2, Windows, and Unix.

**Price:** 18,600 G.  
**Contact:** Incaa Datacom B.V. Appeldorn, The Netherlands  
+31 55 551262  
fax: +31 55 558381.

**Circle 1322 on Inquiry Card.**



## CD-ROM AND ERASABLE DISK COMBINATION

ImageStore combines a quad-speed CD-ROM and 650-MB erasable optical disk in the same drive unit. The core of the LF1004 drive is the Panasonic PD system, and ImageStore enhanced the unit's connectivity to Unix systems. The LF1004 comes in internal and external versions. They look and feel like a hard disk. External packaged units include a case with a power supply. The ImageStore LF1004 supports the following operating systems: Windows for Workgroups, Windows 95, Windows NT, OS/2 Warp, DOS, Novell, and Mac.

**Price:** starts at £599.  
**Contact:** ImageStore, Basingstoke, U.K.  
+44 1256 24100; fax: +44 1256 336559.  
**Circle 1328 on Inquiry Card.**

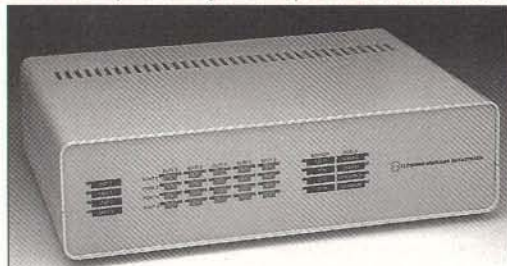




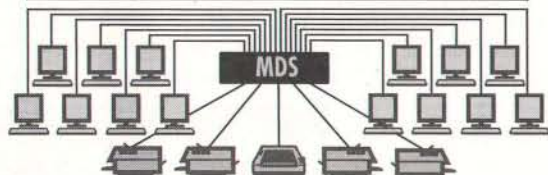
# MODULAR PRINTER SHARING

## Stop searching

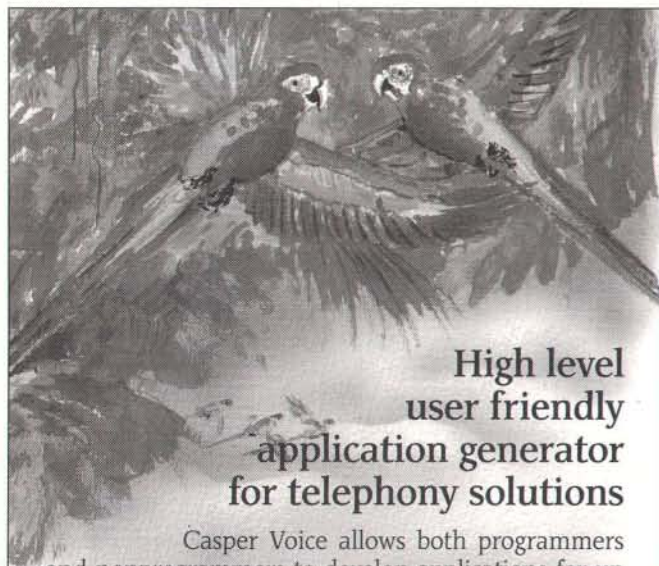
This is what you were looking for. A Modular Data System with all functions you need. The unit combines all advantages and functions of similar units on the market. One or more printers can be connected to individual workstations or LANs. The MDS system is an advanced modular printer sharing unit developed with the customers needs in mind.



■ Highspeed 40.000 char/sec ■ 16.8 Mb ■ Par.&Ser.Mixed  
■ Spooler Software ■ Modular - 20 Ports



Nijental 42, 3972 KC Driebergen The Netherlands Phone +31-3438-18724 Fax +31-3438-12286  
Germany: Phone +49-2137-95900 Fax +49-2137-959095 Poland: Phone+48-22-269653 Fax:+48-2-63351182  
Italy: Phone/Fax +39-2-93548372 Belgium: Phone+32-2-5692934 Fax +32-2-5697018



## High level user friendly application generator for telephony solutions

Casper Voice allows both programmers and nonprogrammers to develop applications for up to 30 ports per PC, using a wide range of Dialogic products. Future users of Casper Voice are offered a demo diskette free of charge.

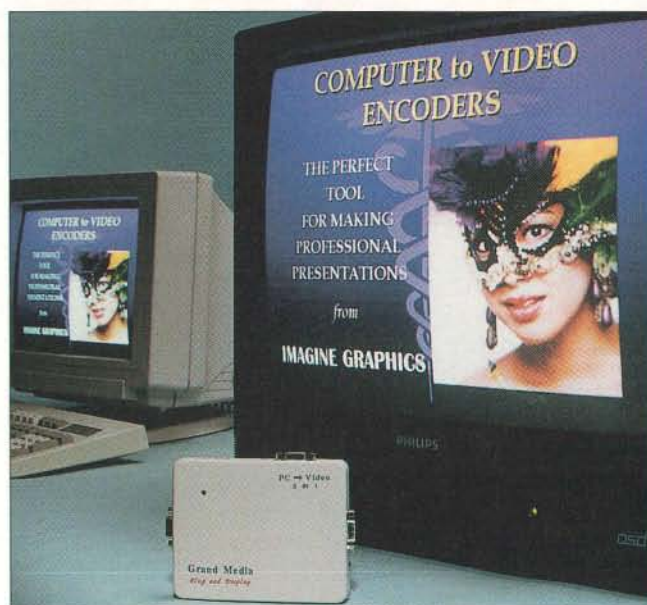
# Casper

Roskildevej 126  
4100 Ringsted  
Denmark

Phone +45 57 67 30 00 · Fax +45 57 67 40 45

Used by BT Laboratories, Nortel and Philips

## WHAT'S NEW



### CONNECT YOUR PC TO A TV ▲

Grand Media is a PAL converter for the PC and Apple Macintosh. It converts a computer's graphics output for display on any standard TV with composite video, and an S-VHS or SCART connector. The pocket-size unit was designed as a companion to desktop or portable computers when users need to give a presentation to a group audience. It requires no extra software. The device uses frame-buffer and digital-video filtering technologies to ensure stable and flicker-free display of the converted images. It automatically senses the input frequencies and adjusts for best display position and quality. Frequency ranges of 24-kHz to 38-kHz horizontal and 56-Hz to 72-Hz vertical are supported, making it compatible with graphics modes of 640- by 480-pixel resolution. Displaying at 800 by 600 pixels at 56 Hz is also possible.

Price: £275.

Contact: Imagine Graphics  
St. Albans, U.K.  
+44 1727 844744  
fax: +44 1727 811660.

Circle 1327 on Inquiry Card.

produces an adequate power supply whenever there is a power fluctuation. The system can compensate for electricity that gets as low as 154 V before battery power is required to maintain the output voltage. The developer claims this increases battery life by up to 30 percent. A front-panel LCD lets you monitor over 20 meter functions, including load, battery charge, and voltage. The display is also used to provide alarm messages. A menu system helps in configuring basic setup parameters. LAN management facilities are available through the use of master and slave sockets.

Price: starts at £495.

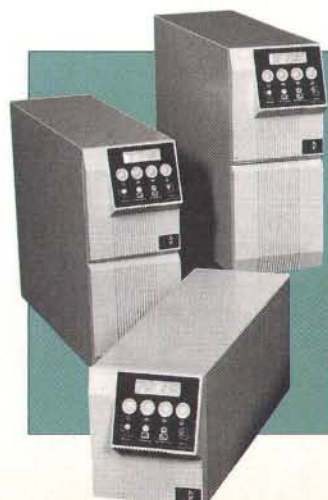
Contact: Galatrek  
International, Ltd.  
Llanrwst, U.K.

+44 1492 643011  
fax: +44 1492 641828.

Circle 1325 on Inquiry Card.

### FILE SERVER PROTECTION ►

Galatrek's new ByteBak UPS (uninterruptible power supply) features a 16-bit microprocessor that checks the power supply 1600 times a second and

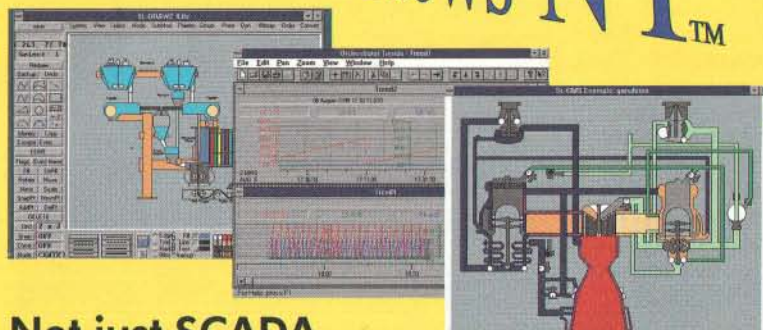




# Orchestrator for Windows NT™

## The New Generation for the New Technology

Data Acquisition  
Data Logging  
Object based GUI  
Client/Server Operation

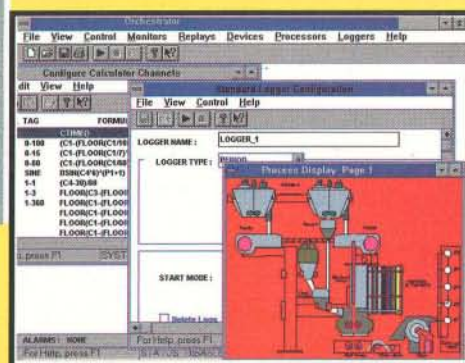


Not just SCADA ...

Not just MMI ...

**EUROSOFT**  
TECHNOLOGY

Eurosoft Technology  
PO Box 5536 Newbury  
Berkshire UK RG13 2YW  
Tel (44) 01635 582660  
Fax (44) 01635 582665



But an integrated Real Time  
Information System

### A NETWORK SERVER FOR 250 USERS

RAD Data Communication launched two network access servers, the TRE-RAS for Token Ring and the MBE-RAS for Ethernet. Each of these machines' eight server ports can be connected to a remote LAN or a remote PC. They offer synchronous and asynchronous data transfer. The attached LAN Ranger client software, running under Windows, DOS, and OS/2, provides user access control and encryption. LAN Ranger is also available for ISDN and is compliant with CAPI 1.1. The TRE and MBE access servers can serve up to 250 users.

Price: DM 7640.

Contact: RAD Data  
Communication  
Tel Aviv, Israel  
+972 3 645 8107

fax: +972 3 498 250.

Circle 1331 on Inquiry Card.

### MULTIPROTOCOL PRINT SERVER

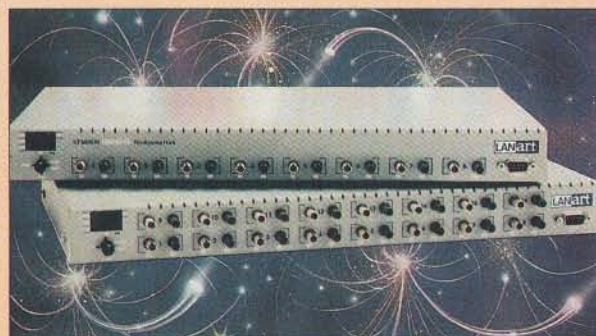
Axis Communications designed its new Axis 150 print server for small LANs running Windows 3.1, Windows NT, Windows 95, OS/2, and NetWare. It is based on an ASIC that consists of a 32-bit RISC CPU and an Ethernet or Token Ring interface. When used with Windows NT, the Axis 150 supports the SMB (Service Message Block) protocol that allows efficient use of your computer's resources to print your document without loading the client software's driver and to use peer-to-peer printing. The attached print utilities for Windows and OS/2 help you install and monitor the printer.

Price: DM 735.

Contact: Axis Communications  
Lund, Sweden  
+46 46 191835

fax: +46 46 136130.

Circle 1330 on Inquiry Card.



### NEW ETHERNET HUBS FROM LANART

LANart International has developed new 8- and 16-port, SNMP-managed, 10Base-E-FL hubs. The hubs can be integrated with the company's 10Base-T expansion hubs, and they can provide a full GUI when used in Hewlett-Packard's OpenView environment. These hubs also support Telnet and can be connected to other Ethernet devices. They include an alert function that will detect physical faults.

Price: £1545.

Contact: LANart International, Cambridge, U.K.  
+44 1223 232535; fax: +44 1223 232747.

Circle 1326 on Inquiry Card.

EXTRA INTERNATIONAL



# WHAT'S NEW Software

## BETTER FONT-LIBRARY MANAGEMENT

Magenta's Font Director lets designers and graphic artists install their fonts in groups according to usage, making it easier to manage font libraries. With Font Director you can load and unload fonts and delete any unused FOT files in order to optimize storage space on your hard disk. You can also display the font layouts and use characters that you can't access from your keyboard, and you can print font samples and character layout tables.

Price: \$70.

Contact: Magenta Ltd.

Athens, Greece

+30 1 724 6947

fax: +30 1 7229292.

Circle 1333 on Inquiry Card.

## MAP YOUR DATA

Maps&Data for Windows can locate business information and graphically display it on your Windows desktop. You can import database or spreadsheet files from programs such as dBase, Access, Paradox, Excel, and 1-2-3. Maps&Data version 3.0 allows you to geocode your data through colors, cross hatching, symbols, and pie and bar charts as well as optional labels. You can create and manage up to 64 layers on one map. The program comes with a range of maps detailing coastlines, administrative boundaries, water features, road networks, and major towns and airports. A map of the U.K.'s postal districts is also available. The program comes in English and French language versions.

Price: £495.

Contact: A.D.D.E.

Levallois-Perret, France

+33 1 47 587841

fax: +33 1 47 58 7646.

Circle 1332 on Inquiry Card.



E U T R O N . C O M P U T E R S E C U R I T Y

## SmartLock

### TOTAL PROTECTION FOR PC AND LAN



**SMARTLOCK** is the integrated protection system which assures total PC and LAN security: unauthorized access to computers, input of illicit software into company PCs, viruses, illicit use of personal computers. Remote and integrated management for LAN applications.

#### PC access control

Prevents unauthorized access to PC. Provides an audit trail recording application programs executed, users and login times. Prevents unauthorized booting. Limits the use of floppy disk drives and peripherals. Executes on-the-fly transparent cryptography of the hard disk.

#### Company software control

Prevents unauthorized execution of illicit unlicensed software. Takes census of company software. Allows controlled distribution of new software licenses via digitally tagged floppy disks.

#### Antivirus

Provides the final solution to the software virus problem without requiring continuous updating. Takes preventive action by intercepting the viruses before they enter the PC, regardless of the type and techniques of attack.

#### Increases performance

Prevents the import of useless software (games, shareware, demos, etc.). Avoids accidental deleting or modifying of files containing vital data. Prevents from modifying CONFIG. SYS and AUTOEXEC. BAT system files.



**EUTRON** 24048 Treviolo Bergamo Italy - Via Gandhi, 12 - Tel. +39-35-201003 - Fax +39-35-201277 - BBS +39-35-201144

■ Belgium: Vicking 011-431272 ■ Finland: Dalma 90-2711800 ■ France: Logidata 1-46454546 ■ Slovenia: Stubelj 065-63215  
■ Sweden: JM Data 042-123145 ■ Spain: Larco 91-7952413 ■ The Netherlands: Akkermans 045-241444

**Eutron**



**MACINTOSH HTML EDITOR ▶**

The P.INK Web Manager is an editor that produces HTML files for a Web page. The Web manager runs on the Apple Macintosh and reads ASCII text and PICT image files. Hyperlinks to other documents are, of course, possible.

**Price:** Free (shareware)  
**Contact:** P.INK Software Engineering

Hamburg, Germany  
+49 40 4117090

fax: +49 40 41170910.

Circle 1341 on Inquiry Card.



Erkrath, Germany

+49 2104 95460

fax: +49 2104 95410.

Circle 1342 on Inquiry Card.

**EVALUATE EMPIRICAL DATA ▼**

TableCurve 2D and TableCurve 3D, two curve-fitting programs from Jandel Scientific, are now available as 32-bit Windows and Windows NT applications. The programs are aimed at physicists, engineers, and other scientists who need to evaluate empirical data, test theoretical models, or generate a calibration curve, providing the equation and the coefficients simultaneously. For interpolation, extrapolation, or projection, TableCurve 2D fits and ranks 3304 linear and 14 nonlinear equations. TableCurve 3D fits and ranks up to 37,231 equations.

Import and export data formats are ASCII, Excel 5.0, and Lotus 1-2-3. The programs can also generate function code in C, FORTRAN, Pascal, or BASIC. **Price:** DM 995.

**Contact:** Jandel Scientific

**3-D RENDERING FOR WINDOWS NT**

With Real Light's rendering software you can create high-resolution photo-realistic images of 3-D environments. Based on a radiosity algorithm, the program lets such professionals as architects and designers who are interested in graphics presentation analyze buildings or mechanical 3-D models from any angle. Real Light can load DXF, 3DS, and NFF files, assign and edit materials properties, and render 3-D models. It runs under Windows NT and SGI IRIX.

**Price:** \$900.

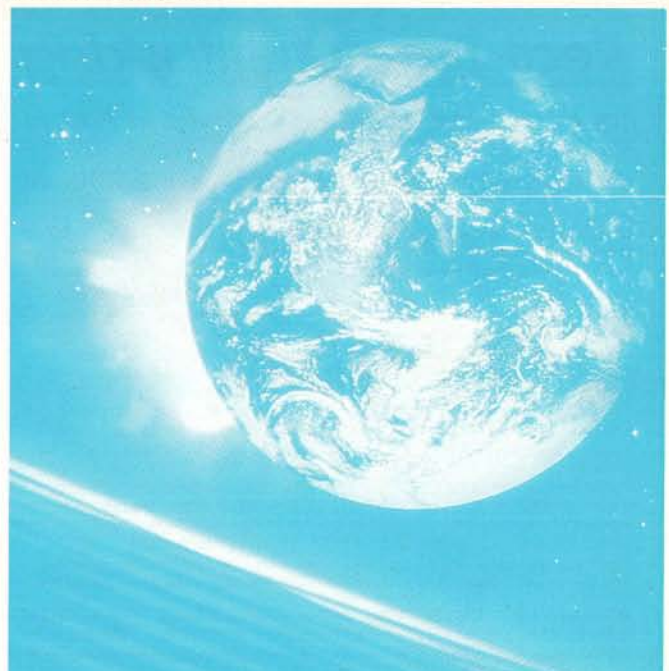
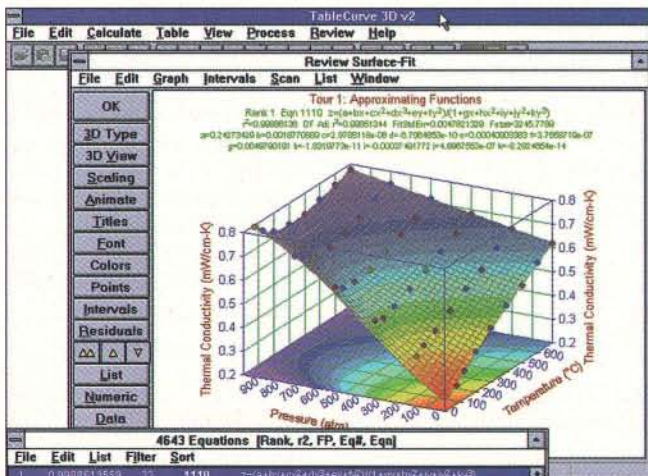
**Contact:** ATMA Srl  
Milano, Italy

+39 2 29531350

fax: +39 2 29531500

http://www.atma.it.

Circle 1335 on Inquiry Card.



## THE STRONGEST PRINTER RANGE IN THE WORLD IS HERE

Here, at your local distributor, is the reliable and high quality dot matrix, line, inkjet and laser printer range from Mannesmann Tally: products for all your applications.

**AUSTRALIA** GPM Systems 03 819 0233 **BAHRAIN** Mantech Computer Services 0731717 **BELGIUM** Tracor Europa NV 02 5820031 **CHINA** Einstein Technology Industries Ltd 7 336 9580 **TAIWAN ROC CYPRUS** The Cyprus Import Corp Ltd 2337033 **DENMARK** Iversen & Martens AS 44921100 **EGYPT** Microsys 02 2916426 **FINLAND** Jertec Oy 90 52711 **GREECE** Unicom SA 01 9430632/3 **HONG KONG** Clever Motion Industries Ltd 07870778 **ICELAND** Einar J Skulason HF 01 633000 **INDIA** Lipi Data Systems 022 2026860 **INDONESIA** PT Panja Indohitech Komputer 021 3101066 **IRAN** Varian Of Iran Co Ltd 21 7762703 **ISRAEL** Alpha Terminals Ltd 03 6487795 **JORDAN** Computer and Communications Systems 844088 **KENYA & EAST AFRICA** Micropower International Ltd 2 540198 **KOREA** International Business Computer Co Ltd 784 8301 **KUWAIT** Sinam Integrated Systems 4834542 **LEBANON** Information Management Ltd 01 601786 **MALAYSIA** Advantage Systems SDN.BHD 3 7033166 **MALTA** Philip Toledo Ltd 444747 **THE NETHERLANDS** Tracor Europa BV 033 536536 **NEW ZEALAND** Pegasus 838 2081 **NIGERIA & ALL ECOWAS COUNTRIES** Isatong Ltd 01 841485 **NORWAY** Merkantildata 2 2095000 **OMAN** Capital Computer Centre LLC 590400 **PAKISTAN** Alrashid Microcomputers (PVT) Ltd 21 442026 **PHILIPPINES** Maxicom 2 6355116 **PORTUGAL** D&R Lda 01 778 7928; Citronic 01 828151 **QATAR** BCQ 325851 **SAUDI ARABIA** National Computer Systems Co 1 479 3916 **SINGAPORE** Kesco Information Technology PTE Ltd 484 1417 **SOUTH AFRICA** Venture Computer Co (Pty) Ltd 11 792 7430 **SPAIN** SDI 1 510 7100; Benet Asociados 1 677 8881 **SWEDEN** MD Distribution 87 520045 **SYRIA** Yazigi & Co 11 2215583 **TAIWAN** Einstein Technology Industries Ltd 7 336 9580 **THAILAND** Yip In Tsoi & Co Ltd 2 236 9294 **TURKEY** Performans 212 288 5260/1; EBIM Ltd 392 228 1543 **UNITED ARAB EMIRATES** International Aeradio (Emirates) 4 523331 **YEMEN** Computer Information Centre 1 226959; Yemen Computer Co 1 208811 **ZIMBABWE** Speciss Computers 4 794661

Call +44 1734 788711 for details of your local distributor or Fax +44 1734 771312  
Mannesmann Tally Ltd., Molly Millars Lane, Wokingham RG41 2QT, UNITED KINGDOM

# MANNESMANN Tally



**Circle 520 on Inquiry Card.**





MEET EUROPE AND COMMUNICATE

**RIGHT TIME.**

**RIGHT PLACE.**



You're a professional. A specialist in computers, software, telecommunications, multimedia, networks or C technologies. Make sure you keep up with the latest industry news. Every autumn. At **SYSTEMS**.



**SYSTEMS 95**

COMPUTERS · SOFTWARE · COMMUNICATIONS

14th International Trade Fair and International Congress

**Munich, October 16 - 20, 1995**  
Circle 554 on Inquiry Card.



## THE ALTERNATIVE UPS HAS LANDED



LUNAR ENERGY COMPANY  
P.O. BOX 2017  
DENTON TX USA 76201, EARTH  
TEL: 817.387.0000  
FAX: 817.383.0747  
MCI @ SPARKY, COMPUSERVE @ 73171, 1440



UNINTERRUPTIBLE POWER SYSTEMS  
"FROM 300VA TO 60KVA"

The Power of the MOON

## HyperMedia Professional

*intelligent large-scale  
management of any type of information*

☐ **information retrieval**  
retrieval by any combination of words  
and, or, not, proximity and adjacency  
dates and numbers with range queries  
support for most wp formats  
support for structured data  
2+Gb text bases currently in operation

☐ **object-oriented hypermedia**  
multilevel multimedia dossiers  
manage any type of digital data  
links automatically established during input  
or manually at any time  
full link control

☐ **monochrome rasters**  
A0 formats and over  
TIFF CCITT G4 compression  
software compression and decompression  
certified Kofax support for fast scanners  
duplex scanning in software  
multiple raster layers  
anchors (hot spot links to multiple documents)  
retrieval through queries on anchored  
documents

☐ **color and grayscale images**  
software ISO-JPEG compression  
multiresolution images  
miniature previews  
conversion and print

☐ **COLD output**  
automatic archival for mainframe print spools  
with indexing and document separation  
image synthesis of spool data over a raster  
background  
storage cost as low as \$1 per 15,000 pages

☐ **full protection**  
☐ **extensive customizing**  
☐ **network, optical disks and  
jukebox support**  
☐ **and more...**

**special version for CD-ROM  
dissemination**

available on:  
Microsoft Windows  
Microsoft Windows NT (Intel and Alpha)  
UNIX (DEC Alpha, IBM Risc/6000, HP PA RISC)

Via Duchessa Jolanda 21  
I-10138 TORINO (Italy)  
Phone: +39 (11) 4341245  
Fax: +39 (11) 4336637  
e-mail: hyper@inrete.alpcom.it

**HYPERSYSTEMS**

Archival and retrieval systems since 1986

## WHAT'S NEW

NTMail			
Domains	Forward	AutoR	Executable
Incoming	Outgoing	Post Office	Configuration
Log	Key	Users	Accounts
Alias	Type	User	Description
brian	Pop	Brian	
dance-events	Exe	dance-events	c:\bin\dance.exe
darran	Pop	Darran	
dave	Forward	David	dave@network.com
devid	Forward	David	dave@network.com
daz	Pop	Darran	
mark	Holiday	Mark	Summer Holiday till 30th July
ntmail-2.10	AutoR	ntmail-2.10	MIME Version of NTMail 2.1
ntmail-html	AutoR	ntmail-html	MIME Version of NTMail HTI
sales	AutoR	sales	Internet Shopper Contact Ad

### SMTP AND POP SERVICES FOR WINDOWS NT ▲

NTMail for Windows is a new mail server for Windows NT. It provides Internet standard SMTP and POP (point of presence) mail services in a full 32-bit multi-thread mode, uses MX records, and can either forward or hold mail for a destination currently not reachable. NTMail can act as an intelligent mail server for Windows 95's Exchange mail system and can be configured to use the NT user database for user validation, or it can use a registry loaded from text files. In addition to the extended POP3 command set, NTMail supports Eudora's "change password" facility.

Price: starts at £40 (two-user license).

Contact: Internet Shopper Ltd.  
London, U.K.

+44 181 673 7422

fax: +44 181 673 8777.

Circle 1349 on Inquiry Card.

bases from Sybase and Oracle.  
Call for price.

Contact: Next Computer, Inc.  
Redwood City, CA  
(800) 879-6398

fax: (415) 780-3990.

Circle 1355 on Inquiry Card.

### MANAGE A NETWORK CRISIS

SiteNet 1 from Emmerson Computer Power protects data by automatically shutting down a server during a power failure. An additional Micro M-Plex interface allows multiserver protection from a single UPS (uninterruptible power supply). The SiteNet 2 module adds UPS monitoring and control and network crisis management.

Price: £86.

Contact: Emmerson  
Computer Power  
Swindon, U.K.

+44 1793 553355

fax: +44 1793 553424.

Circle 1346 on Inquiry Card.

### NEXT RELEASES JAPANESE VERSIONS

Next Computer announced that it is shipping Nextstep 3.3J, Nextstep Developer 3.3J, and Enterprise Objects Framework 1.1J versions of their products for the Japanese market. Both Nextstep Developer 3.3J and Nextstep 3.3J provide support for Intel, HP PA-RISC, SUN, and Motorola 68000-based workstations.

Enterprise Objects Framework 1.1J is Next's first localized release for the Japanese product. Enterprise Objects Framework 1.1J extends Next's object-oriented database technology by integrating object-oriented applications with data from relational Japanese data-

### VIRUS CHECKER

Sophos' Sweep for Windows virus checker is now available for Windows NT. It allows network managers to check directly for DOS and Windows viruses on file servers and workstations. Intercheck, a Sweep module, extends the checking to every PC on a network. It verifies every unknown program before allowing it to run.

Price: £495 per year for up to 25 users; £895 for over 25 users.

Contact: Sophos Place  
Abingdon, U.K.

+44 1235 544017

fax: +44 1235 559935.

Circle 1352 on Inquiry Card.



# OPTIMIZING PowerPC CODE

Programming the  
PowerPC Chip in  
Assembly Language

Gary Kacmarcik

## How to Optimize Your PowerPC Code

TOM THOMPSON

The PowerPC market is growing, and many books covering the programming of this processor are being published. *Optimizing PowerPC Code* by Gary Kacmarcik tells how to write faster native code. The book starts with functional descriptions of the PowerPC 601's architecture and instruction set. The author describes such features as cache operation and branch prediction logic.

Once this groundwork is complete, Kacmarcik moves on to optimization tricks. Some of these are standard fare: using right shifts to replace multiply operations and multiplication to replace expensive divide operations (for numerous divide operations, multiplying with a reciprocal is faster). Other tricks involve mixing the instruction stream so that all the execution units are kept busy and avoiding pipeline stalls by modifying certain code structures, such as loop unrolling and code pasting (i.e., placing code-block duplicates elsewhere in an algorithm to increase the number of independent instructions that can be sent to execution units). Finally, there are nitty-gritty details about specific register dependencies and what can be done to avoid them.

It's important to note that this subject is discussed at a fairly high level. For example, the loop-unrolling examples are in C, although certain sections are peppered with assembly language output. Also, there's no treatment of development tools or a specific machine environment (e.g., the Power Mac's code implementation). However, the broad treatment Kacmarcik uses lets these techniques be applied to all PowerPC systems.

Tom Thompson is a BYTE senior technical editor at large who is the author of *Power Macintosh Programming Starter Kit* (Hayden Books, 1994). You can reach him on AppleLink as T.THOMPSON or on the Internet or BIX at tom\_thompson@bix.com.

### OPTIMIZING POWERPC CODE

Gary Kacmarcik  
Addison-Wesley  
ISBN 0-201-40839-2

\$39.95

## ESTABLISH A WEB BEACHHEAD

**MARKETING ON THE INTERNET: MULTIMEDIA STRATEGIES FOR THE WORLD WIDE WEB** by Jill H. Ellsworth and Matthew V. Ellsworth

John Wiley & Sons, ISBN 0-471-11850-8, \$24.95

In the search to find yet another angle for an Internet book, the Ellsworths key off the current hot topic: commerce on the Net. Unfortunately, the book never addresses the question of how profitable on-line companies are. Instead, the authors quote gee-whiz statistics about how fast the Net is growing and imply that growth equates to profits for companies on the Net. Buying studies have yet to prove that's true, however.

But if you're a true believer in Net commerce, or are afraid that you're letting a business opportunity slip by, this book provides a handy starting point for establishing your company on the Net. At its best, the book offers practical advice on what makes a home page attractive and easy to navigate. At its worst, it's a rehash of Net introductory material that you'll find in dozens of other books.

Most appealing are the step-by-step examples of HTML (Hypertext Markup Language) code that show you how to format ASCII text and embed hypertext links for documents you want to publish on the Net. The authors also show how the same HTML text appears when viewed by different Web browsers. The core of *Marketing on the Internet: Multimedia Strategies for the World Wide Web* offers solid advice for businesspeople itching to establish a Web site. But, like the Net itself, you'll have to sift through some extraneous material to get to the good stuff. ■

—Alan Joch



## SHOOT POOL AND/OR RELIVE THE SIXTIES

**VIRTUAL POOL** Interplay Productions,  
17922 Fitch Ave., Irvine, CA 92714,  
(714) 553-6655, \$39.95

If you like to play pool, you'll love the Virtual Pool CD-ROM. Its developers really sweated the details. All the physics of the real game are there, such as friction, cushion response, and cue ball spin. You can line up a shot by "walking" around the table, move closer, back away, and even attempt a trick massé shot.

In addition to eight-ball, you can play nine-ball, rotation, straight pool, and snooker. You can play against your computer, against a friend, or with other players via a modem or over a network. Virtual Pool runs under DOS 5 or higher on PCs with at least a VGA card, 2 MB of RAM, 2 MB of hard disk space, and a Sound Blaster-compatible sound card.

### HAIGHT-ASHBURY IN THE SIXTIES

Compton's NewMedia, 2320 Camino Vida Roble,  
Carlsbad, CA 92009, (619) 929-2500, \$49.95

During the 1960s, the San Francisco district of Haight-Ashbury was a center for youth rebellion, the antiwar movement, and major cultural and artistic experimentation. Free love, flower power, hippies, and great music flourished. Haight-Ashbury in the Sixties captures many of the personalities of the time, including Allen Ginsberg and Timothy Leary, as well as music from the Grateful Dead and Jefferson Airplane. There's even an adventure game that lets you explore Haight St. The CD-ROM runs on an MPC with Windows 3.1 or a Mac with System 7.0.

—Rich Friedman



A time of youth rebellion.





You know how applications look.



You know how to click a mouse.



You know how to draw a line.



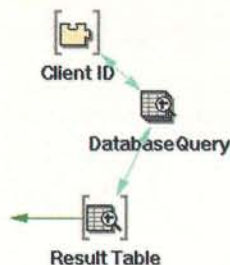
You know how to watch



a computer do all the work.







# This concludes your training in OO programming with VisualAge.

No one's debating the benefits of object-oriented programming. The only question is whether it's worth the time and money it would cost to implement.

With VisualAge™, the question may be irrelevant. Because its simplicity can easily remove the barriers between you and the fast development of object-oriented applications.

VisualAge is light years beyond mere GUI builders. It's a graphical environment that takes you through the entire process, from interface design to working application. As *InfoWorld* puts it, "a masterpiece of visual programming."

With the C++ edition, you work with "parts" from IBM's Open Class Library, creating visual links between them. They're easy to modify and compliant with standards, so they can be used across

platforms, from PCs to the biggest servers.

When your project is complete, you've created an application with industry-standard code (C++ or Smalltalk). And in a fraction of the traditional development time, you're ready to deploy a true object-oriented application, with solid components that can easily be used

over and over in future projects.

Of course, your

full OO solution requires even more. That's why IBM offers more OO products, consulting, education and services than any other software company. To quickly take advantage of OO technology, call 1 800 IBM-3333 ext. GA 070 or visit <http://www.software.ibm.com>. You'll

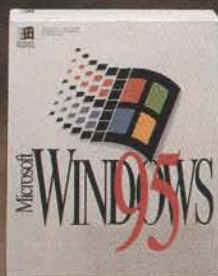
find that you've been in training for VisualAge all your life.



Solutions for a small planet™



On August 24, the future begins.



Hear it now.



Wire it in.



Experience it all.



To really see and hear all of Windows 95, you will need the best next generation hardware.

Like the affordable Sound Blaster® 32. This next generation Sound Blaster features wave-table synthesis, CD quality, 16-bit digital audio and incredible 3D sound capabilities. And, because it's a genuine Sound Blaster, you know it works with all your favorite multimedia titles.



Then there's Modem Blaster™ 28.8. Wire yourself into the internet and play the hottest games modem to modem with the fastest modem available.



Of course, your system won't be complete without Blaster CD™ 4x. Use the power and performance of quad-speed CD-ROM to take full advantage of the latest multimedia titles.

For more information on these next generation products, see your Creative Labs dealer.

Do it now. And make Windows 95 all it was meant to be.



**CREATIVE™**  
CREATIVE LABS, INC.  
multimedia *iSSs* Creative



# Assets on the Line

**SALVATORE SALAMONE**

**Y**ou're planning a big vacation trip, so you call Human Resources to see how many vacation days you have. "Well, we don't know exactly—somewhere between 10 and 20." Makes it somewhat hard to plan, wouldn't you say?

Strangely enough, IS managers trying to support end users are in a similar situation. They often lack accurate—and essential—information about the quantity and types of hardware and software their users are working with.

The vendor community has responded to the demand for such inventory information with a multipronged approach. Some software utility vendors, such as Frye Computer Systems (recently acquired by Seagate), Horizons Technology, McAfee Associates, Microsoft, Microsystems Software, Saber Software, Symantec, and Tally Systems, offer asset management software that performs hardware and software inventory of network-attached PCs, Macs, workstations, and servers.

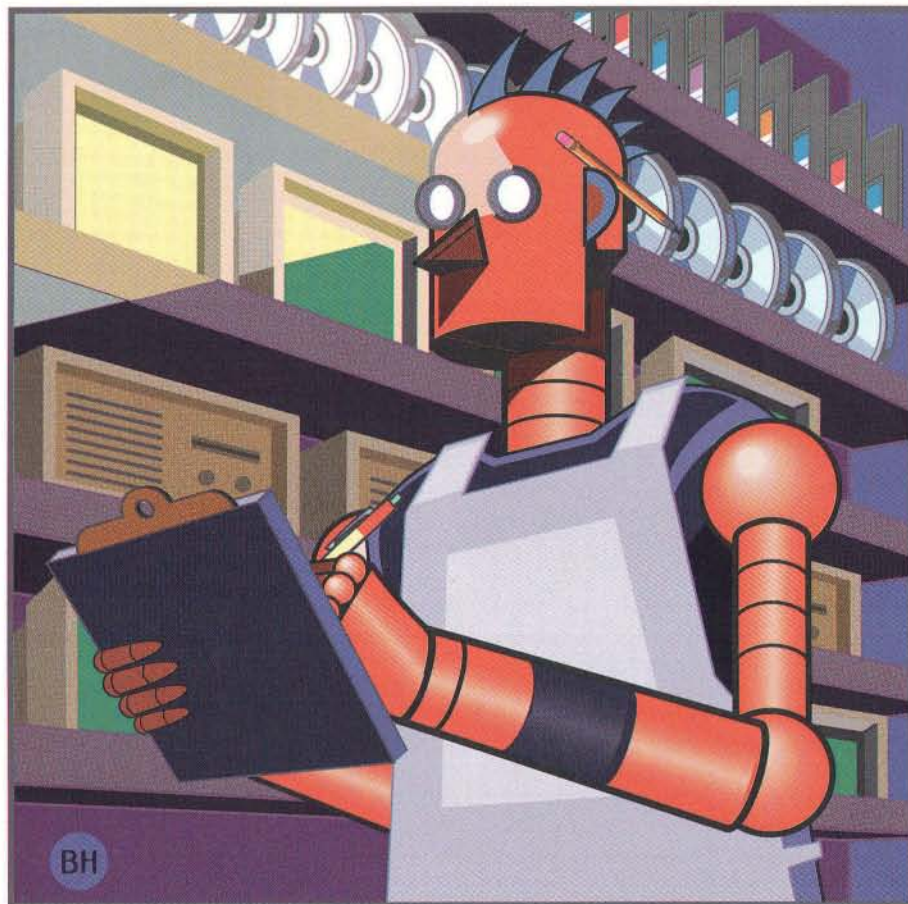
The DMTF (Desktop Management Task Force), which is an industry consortium of hardware and software vendors, has developed a specification that provides a standard way to inventory computer equipment over a network. Today, DMTF-compliant products are finding their way to market.

Server and PC manufacturers, such as AST, Compaq, Dell, and NEC, are beefing up their products by adding firmware that performs a hardware inventory and makes this information available to network management programs.

Finally, if you don't want to do it yourself, outsourcing firms that specialize in network management, such as NetSolve and Hewlett-Packard's service organization, shrewdly offer configuration and asset management services as well.

## Counting the Beans

All these alternatives aim for the same goal: a more accurate picture of the hardware and software throughout an organization, based on the detailed inventory information they collect. Traditionally,



BRAD HAMANN © 1995

**Computer asset management, using automatic hardware and software systems, can simplify administration and save money**

tionally, such inventories have been performed by hand—with a screwdriver—going from desktop to desktop. But such manual inventories have countless drawbacks.

Labor is required to perform an inventory, typically half an hour per PC, according

to the PC Asset Management Institute. For one or two PCs, that's OK. But for a less modest collection of 2000 PCs, that means 1000 hours, or half a year for a full-time IS staffer doing nothing but inventory. Major snore, major expense.

A second disadvantage to manual inventory is that the information collected quickly becomes outdated. The once-a-year inventory becomes obsolete as soon as a user installs a sound card.

It's little wonder that most organizations either have no inventory or use an outdated one. As a result, they are constantly performing ad hoc inventories every time they need accurate information—whether buying memory to upgrade PCs or merely

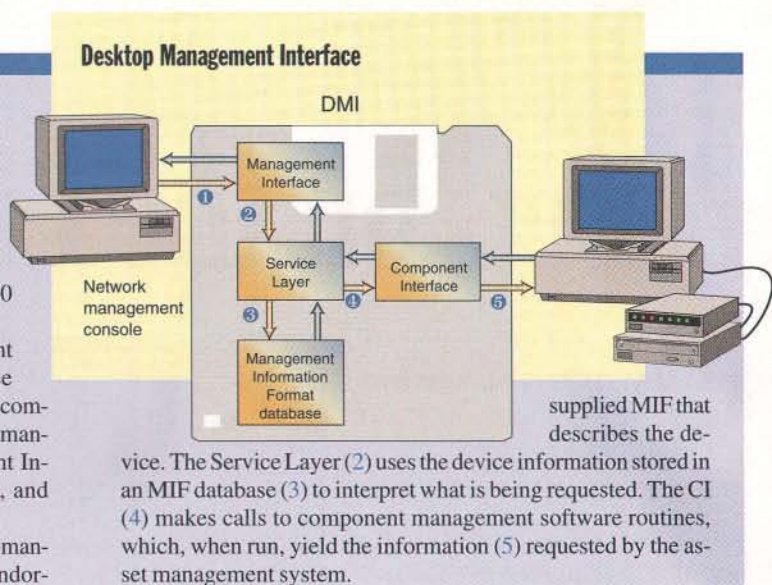


## Looking Under the Hood

The DMTF (Desktop Management Task Force) has finalized its DMI (Desktop Management Interface) specifications that, once adopted by equipment manufacturers, will make hardware inventory easier. Over 150 vendors have already pledged support for the standard.

Basically, DMI defines a format of a management agent for desktop systems. Its layered-model architecture (see the figure) allows a wide range of software and hardware components to pass information about themselves to an asset management system. The layers include an MI (Management Interface), a Service Layer, a CI (Component Interface), and MIFs (Management Information Formats).

The MI passes requests for information (1) from the asset management system to the device. Each component has a vendor-



device. The Service Layer (2) uses the device information stored in an MIF database (3) to interpret what is being requested. The CI (4) makes calls to component management software routines, which, when run, yield the information (5) requested by the asset management system.

troubleshooting a problem on a single PC.

Whatever the reason, according to a survey of 106 network managers conducted by Infonetics Research (San Jose, CA), companies spend an average of 40 hours per month performing asset and inventory management. Put another way, a week's salary is spent every month for such impromptu inventories.

### Enter the Robot

For these reasons, it makes sense to automate as much of the inventory process as possible. That's most often what the products from software utility vendors do. Typically, asset management programs, such as Norton Administrator for Networks 2.0 from Symantec and NetCensus from Tally Systems, automatically collect detailed hardware and software inventory from servers and nodes on a network.

These products run in different networking environments (see the table "Asset Management Software"). Some are NLMs (NetWare loadable modules) and run only on Novell NetWare LANs. Others are NOS-independent (network operating system).

Programs that inventory hardware collect information about a wide range of hardware components (see the screen on page 40). This includes processor type, disk drives, BIOS, serial and parallel ports, installed RAM—even the network adapter card, and whether a mouse or game port is installed.

Programs that inventory software collect information about the system files, drivers, and applications installed on machines, including version number and the

date and time applications were created.

Automatically collecting hardware and software inventory information has typically required proprietary approaches. Often, hardware inventory programs use a custom-developed TSR program running on each PC that queries the machine's hardware and passes this information to a server-based inventory program.

For software inventory information, most vendors take a brute-force approach and simply compile lists of hundreds to thousands of common programs, typically including the name of each executable file as well as its size and date. The inventory program simply looks for executable files and compares the name, size, and date to the list to determine what versions of what programs are installed. A number of tricks make sure the version number is correct, including checking the time stamp, because many applications set that time to the version number. For example, the ex-

ecutable files for Norton Desktop for Windows 3.0 carry a time stamp of 3:00 a.m.

While these techniques instantly inventory equipment attached to a network, laptops and stand-alone computers typically run a separate program. It saves inventory information on a floppy disk that can be sneakernetted and incorporated into the corporate inventory database.

### Stand and Deliver

These methods for taking inventories of hardware and software work fine to a point. If only these products would become more assertive and tell asset management systems more about themselves. For example, hardware components should be able to identify themselves to an asset management system, rather than having to run a TSR on every machine.

Two industry initiatives are tackling this goal. For software inventory, LSAPI (Licensing Service API) includes program

### ASSET MANAGEMENT SOFTWARE

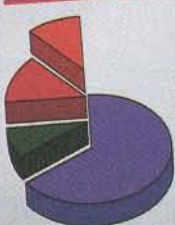
COMPANY	PRODUCT	NOS SUPPORT	CLIENTS SUPPORTED	INTEGRATED WITH UPPER-LEVEL MNGT. SYSTEM?
Frye Computer Systems, Inc.	Smart	NetWare	DOS, Windows, OS/2, Macintosh	Yes
Horizons Technology, Inc.	LANauditor	NOS-independent	DOS, Windows, OS/2, Macintosh	No
McAfee Associates, Inc.	LAN Inventory	NetWare	DOS, Windows, OS/2, Macintosh	Yes
Microsoft Corp.	Systems Management Server	NT, NetWare	DOS, Windows, OS/2, Macintosh	Yes
Microsystems Software, Inc.	Software Sentry	NOS-independent	DOS, Windows	No
Novell and Intel	Managewise	NetWare	DOS, Windows	Yes
Saber Software Corp.	Saber Enterprise Application Manager and LAN Workstation	NetWare	DOS, Windows, OS/2, Macintosh	Yes
Symantec Corp.	Norton Administrator for Networks	NOS-independent	DOS, Windows	Yes
Tally Systems Corp.	NetCensus	NOS-independent	DOS, Windows	No



## Sales-O-Gram

To: All Sales Representatives  
From: Kenton O'Keefe  
Sales Manager  
Subject: Persuasive power of color presentation

- Color increases ad readers
- Color ad increases sales 42%
- Color documents provide
- Color improves attention

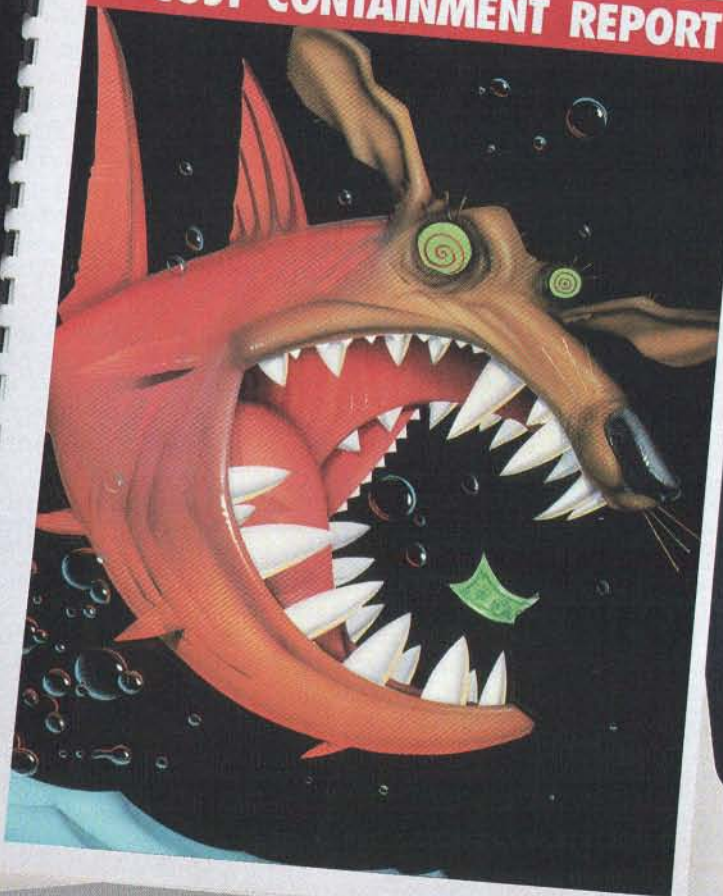


proves  
on per  
back

Bottom  
Agreement  
Comprehension  
Attention  
Perceptions

(1) CARR Report No. 119-5A "Does Colorship?", Colquhoun Publishing Co.  
(2) "Update on split run tests on sales #20"; Internal report of color versus black and white per Association of America.

## COST CONTAINMENT REPORT



## Business Color Printer

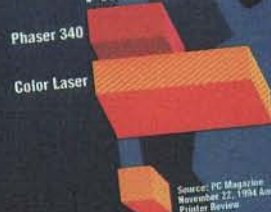
### COLOR PPM



### COST PER PAGE



### PRINTER PRICE



Source: PC Magazine  
November 27, 1994 Annual  
Printer Review

**Tektronix**

# Color is color, unless it's brilliantly practical.

**It's the business printer you've been waiting for.**

Professional color so reliable, inexpensive and easy to use, it's a practical office tool. Speed? It's the world's fastest desktop color printer at 4 color pages per minute. Cost? Full text pages on plain paper at 3¢ each. Color for 11¢ on office papers. Simplicity? If you can load a stapler, you've mastered this machine. Reliability? Add 700 sheets and let

it run overnight. That's robust. Price? At \$4,995, nothing in its performance range even comes close. Best of all, it's from Tektronix, an industry leader, making world-class color printers for 13 years.

**The Phaser 340 Color Printer.**  
**So practical, it's brilliant.**



Call 800/835-6100, Ext. 1037.  
<http://www.tek.com/CPad?1037>

© 1995 Tektronix, Inc. All rights reserved

**Tektronix**

Circle 90 on Inquiry Card.



Hardware Inventory-Parts		
Part	Description	
10	GAMEPORT	No
11	HARDDISK0	Type: 16 Size 204MB
12	HARDDISK1	Type: 0 Size 0MB
13	FX	IpxVer. 3.10 Shell Ver. 3.26 Rev. A
14	LANCARD	Type: Intel EtherExpress(tm) 16 v1.09EC 91C905
15	LANCARDCFG	Configured at IRQ = 10, I/O = 360h
16	MOUSE	Yes
17	NETADDRESS	00A40074FD30
18	NETBIOS	No
19	RECELEMENT	Component Number: Y1

Asset management programs, such as Saber's LAN Workstation (shown here), typically display a wide variety of configuration information.

calls that provide a common way for applications to pass licensing information to an inventory or metering function. The inventory function itself can be either part of a NOS or a third-party utility program.

Microsoft and Novell plan to include LSAPI in their OSes. Other interested vendors include Apple Computer (Cupertino, CA), Banyan Systems (Westborough, MA), Digital Equipment (Maynard, MA), Lotus Development (Cambridge, MA), McAfee Associates (Santa Clara, CA), Oracle (Redwood Shores, CA), and WordPerfect (Orem, UT). As with most standards, adoption of LSAPI has been a slow process. However, once LSAPI is commonly deployed in applications, it will be easy for administrators to identify software on their networks.

On the hardware inventory front, the DMTF is leading the way with the DMI, which specifies a common way of accessing the hardware and software components in a desktop PC. DMI lets management systems access the information about a PC's internal components. The DMTF's CAPI (Common API) will simplify writing applications that access information about a machine's innards (see the text box "Looking Under the Hood" on page 38).

Heavyweight members of the DMTF include Digital, HP, IBM, Intel, Microsoft,

Novell, and SunConnect. Most major PC manufacturers, including AST, Compaq, Dell, and NEC, are incorporating DMI-compliant components into their PCs.

The fourth inventory method, as mentioned above, involves outsourcing vendors who are gearing up to provide inventory and asset management services.

Such companies say they will charge between \$3 to \$8 per box per month for inventory services. For an organization with 2500 PCs, that translates to \$90,000 to \$240,000 per year.

## Benefits Aplenty

That's a lot of money to pay outsiders just to take inventory. Why would anyone pay so much for something that simple? Probably to save money in the long run. After all, a typical PC's purchase price accounts for only about 12 percent of the total cost of ownership over its lifetime, according to the Gartner Group. The other 88 percent covers administrative factors, such as inventory, training, and auditing costs. A 1994 survey of the Help Desk Institute found that 82 percent didn't know how much each support call cost them. Guesses ranged from \$1 to \$75. According to a survey of 180 large user organizations conducted by Business Research Group (Newton, MA), LAN support costs \$778 per user per year on NetWare LANs. A Forrester Research (Cambridge, MA) study found that, for a 5000-user network, it costs three times more to support LAN users than it would to support those same users on an SNA (Systems Network Architecture) network.

Only within the last few years have such recurring management costs become an

issue. Before that, the true costs of managing PCs and LANs were hopelessly scattered among numerous departmental operating budgets. But as organizations have recently tried to regain control of departmental LANs, these costs have been consolidated into one operating budget, and the magnitude of the expense has become horrifyingly apparent.

Many companies can also reduce support expenses by ensuring that products still covered by warranties are serviced by their vendors. And warranty information can easily be stored in a company hardware inventory database.

Asset management information can identify trends and head off problems before they occur. For example, by using equipment service histories (stored in an asset management database) to become proactive in preventive maintenance, a company can cut costs for emergency repairs.

So, what's an effective asset manager to do? First, it is to your advantage to buy DMI-compliant products (and insist that vendors offer them). Second, you can simplify many lives by looking for inventory programs that link into help-desk systems or higher-level management systems. Third, despite the overt expense, consider outsourcing the process if your staffing levels are low.

The bottom line is that costs to support computer software and hardware dwarf the purchase price. Asset management can provide information that is key to reducing those costs, and maybe make that vacation happen after all. ■

*Salvatore Salamone is a BYTE news editor based in New York and author of Reducing the Cost of LAN Ownership (Van Nostrand Reinhold, 1995). You can reach him on the Internet or BIX at ssalamone@bix.com.*

## Product Information

**LANauditor** \$495 for 50 users  
Horizons Technology, Inc.  
San Diego, CA  
(800) 828-3808  
(619) 277-7100  
fax: (619) 292-9439

**Circle 1228 on Inquiry Card.**

**LAN Inventory** \$699 for 100 users; \$999 for 250 users  
McAfee Associates, Inc.  
Santa Clara, CA  
(800) 866-6585  
(408) 988-3832  
fax: (408) 970-9727

**Circle 1229 on Inquiry Card.**

**Managewise** \$795 for five-user license; \$6975 for 250 users (combines Novell's NetWare Management System and Intel's LANdesk Manager)

Novell, Inc.  
Provo, UT  
(800) 453-1267  
(801) 429-7000  
fax: (801) 429-5155

**Circle 1230 on Inquiry Card.**

Intel Corp.  
Santa Clara, CA  
(800) 548-4725  
(408) 765-8080  
fax: (408) 765-1821

**Circle 1231 on Inquiry Card.**

**NetCensus** \$10 to \$20 per PC depending on the number of licenses

Tally Systems Corp.  
Hanover, NH  
(800) 262-3877  
(603) 643-1300  
fax: (603) 643-9366

**Circle 1232 on Inquiry Card.**

**Norton Administrator for Networks 2.0** \$58 per node for 100-user license; \$44 per node for 1000-user license  
Symantec Corp.  
Cupertino, CA  
(800) 441-7234  
(408) 253-9600  
fax: (408) 252-4694

**Circle 1233 on Inquiry Card.**

**Saber Enterprise Application Manager** \$695 per server  
Saber Software Corp.  
Dallas, TX  
(800) 338-8754  
(214) 361-8086  
fax: (214) 361-1882

**Circle 1234 on Inquiry Card.**

**Smart** \$495 for 100 users; \$3795 for 1000 users  
Frye Computer Systems, Inc.  
Boston, MA  
(800) 234-3793

(617) 451-5400  
fax: (617) 451-6711

**Circle 1235 on Inquiry Card.**

**Software Sentry** \$595 for 250 users  
Microsystems Software, Inc.  
Framingham, MA  
(800) 489-2001  
(508) 879-9000  
fax: (508) 626-8515

**Circle 1236 on Inquiry Card.**

**Systems Management Server** \$649 per server  
Microsoft Corp.  
Redmond, WA

(800) 426-9400  
(206) 882-8080  
fax: (206) 936-7329  
**Circle 1237 on Inquiry Card.**





# You Can Take It with You

JEFFREY FRITZ

**R**emote access used to be the lifeline you clung to in your hotel room after you realized your presentation was home alone on your hard drive 3000 miles away. But today, remote-access networks are the foundation for companies that don't see corporate headquarters as ground zero anymore. Just as much action is taking place in the field, on the road, or in branch offices.

The trick is to select the right technology or mix of technologies that can make it easy for far-flung workers to reliably connect to your company's main network. More and more, digital-service WAN technologies are becoming part of this mix because they're faster and more dynamic than T-1 or 56-Kbps leased lines.

But even today, no one-size-fits-all solution exists for all companies, and venerable technologies still play a role in WAN connections. Your choices will depend on whether you need full-time point-to-point connections for a branch office, or more temporal connections for mobile workers or telecommuters. Many companies require a combination of these two choices.

## Remote Gets Real

The need for efficient remote access has grown in part because work can get done faster if you're closer to a customer site, or because workgroups are better if they're built on expertise rather than on geographical proximity. Either way, employees throughout an enterprise need to make business decisions with the same data that's available at headquarters.

Alternately, people in the home office often need immediate access to the expertise of workers in the field, who may be able to spot business trends faster than those in a central location. In addition, telecommuting is becoming a way of life for more and more people. LINK Resources Corp., a New York-based market research firm, says the U.S. work-at-home market grew to more than 40 million people last year.

Digital technologies shine in those applications because of

## ISDN and other digital services provide more ways to connect users to corporate networks

high throughput. Basic ISDN service, for example, provides for bandwidth of 128 Kbps, while a less commercialized technology such as ATM (asynchronous transfer mode) can scale up to more than 600 Mbps. Although 128 Kbps can seem like a narrow pipe for LANs, WAN devices can make the most of it with compression and filtering. At the same time, network administrators can use protocol filtering to reduce superfluous traffic over the WAN, especially by eliminating multicast and broadcast packets. Address filtering allows only packets addressed to the remote destination to pass across the WAN. If filtering and compression are not enough, digital devices, including those for ISDN, can provide additional bandwidth-on-demand by automatically allocating and binding extra channels based on current traffic requirements.

## Cutting Costs with Contention

Digital dial-up connections make sense in another way: They reduce the amount of line-termination equipment a company



ANDREA BARUFFI © 1995



must purchase. With leased lines, there is one-to-one correspondence between devices (such as bridges or routers) in the field and allocated ports in the central or hub site. Frequently, network managers use the ratio of devices in the field to available ports at the hub as a way to size up their network connections. This ratio, called *contention*, is based on the assumption that all users will not simultaneously try to connect to the enterprise.

Contention reduces the amount of money you have to spend on lines and hub equipment. For example, a company might have 400 telecommuters, but no more than 50 are expected to be on line at any given time. Rather than installing 400 network ports at the enterprise hub, the company can connect 50 ports in a "roll down" configuration—8:1 contention. Users dial a common telephone number and connect to the first available port. When the fifty-first caller attempts to connect, he or she will get a busy signal and will need to attempt the connection later. (In some advanced hubs, an administration program keeps track of call attempts. When a hub

port opens up, the unit will call the remote user back.)

Finding the optimal contention ratio is an iterative process. Setting contention too low wastes resources and is unnecessarily expensive. Setting contention too high results in call blocking and user frustration. Typically, network administrators will make a conservative guess and monitor access requests to see if the contention threshold is realistic. Once an administrator has some feel for typical usage, contention can be fine-tuned as needed.

### Permanent Connections

Despite the performance advantages of digital technologies, it's not always easy to determine the price/performance cut-over point between leased lines or analog phone lines and digital links. T-1, at 1.544 Mbps, or 56-Kbps leased lines are the traditional ways to connect branch offices to a headquarters' LAN. Leased lines are particularly advantageous if you can count on a stable level of communications activity, which will help you cost-justify this type of connection. That's because leased lines

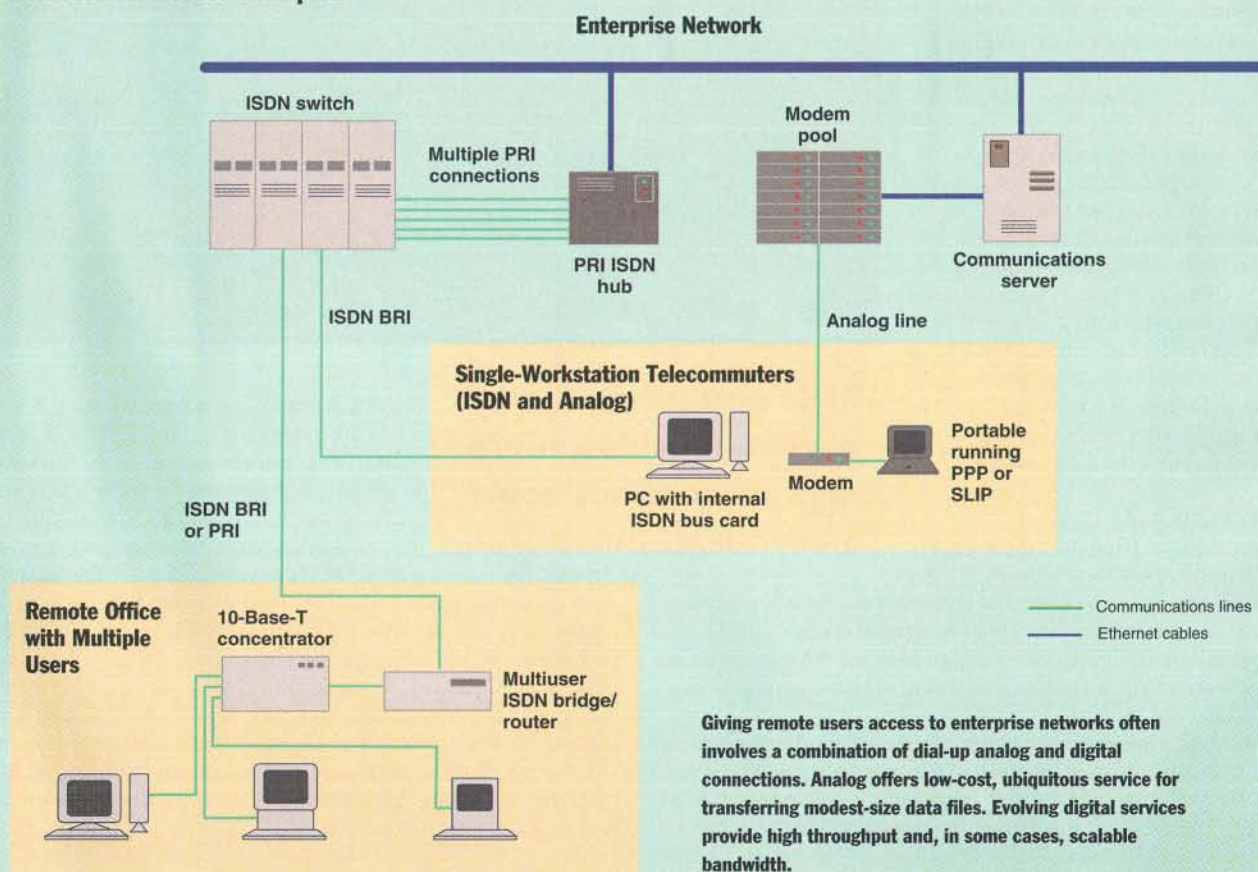
operate at a fixed monthly cost, no matter how much data you're pumping through them. Leased lines are an economical choice if you can find a way to constantly use them; for example, by making them communications links during business hours and data pipelines during the night to update corporate databases.

However, life isn't always predictable enough for leased lines. Your company may need connections to remote offices for only a few hours a day. In this case, high-speed modems (which we'll discuss later) or switched digital networks are better choices than leased lines. Switched networks establish connections only when the need to communicate exists. When there's no communications, the line shuts down and charges are no longer incurred.

### ISDN's Promise

In areas where it's available, ISDN is particularly suited for remote access because it can build upon traditional dial-up strategies where users dial in with modems over analog phone lines. ISDN can handle everything from connecting a single user

## Remote LAN Access Examples



Giving remote users access to enterprise networks often involves a combination of dial-up analog and digital connections. Analog offers low-cost, ubiquitous service for transferring modest-size data files. Evolving digital services provide high throughput and, in some cases, scalable bandwidth.



**Y**ou're ready to make the move to Microsoft's new 32-bit Windows 95 operating system.

The most powerful PC operating system you've

ever experienced. But before you do,

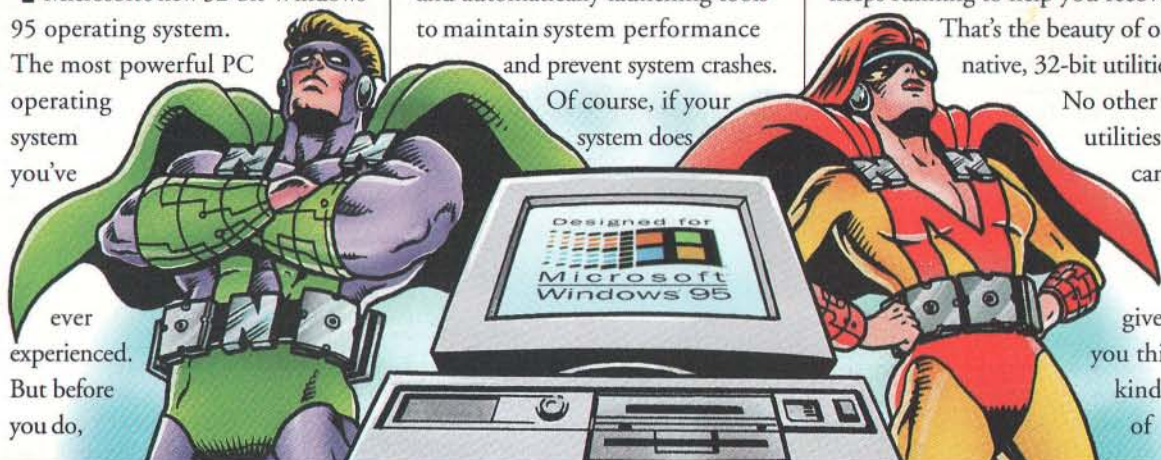
background, monitoring your system and automatically launching tools to maintain system performance and prevent system crashes.

Of course, if your system does

Norton Utilities for Windows 95 keeps running to help you recover. That's the beauty of our native, 32-bit utilities.

No other utilities can

give you this kind of



## NORTON UTILITIES PROVIDES THE ONLY AUTOMATIC DATA RECOVERY AND CONTINUOUS SYSTEM PROTECTION FOR WINDOWS 95.

upgrade your utilities to Norton Utilities® for Windows 95.

### IT'S A 32-BIT WORLD OUT THERE.

You already know Norton Utilities is the best set of tools for system protection, hard disk optimization and data recovery.

What you may not realize is that your current 16-bit utilities won't run under Windows 95.

And the simple utilities found in Windows 95 itself don't offer sufficient data protection for life in a 32-bit world.

Which is why you need the new Norton Utilities for Windows 95.

The first thing Norton Utilities for Windows 95 will do for you is tune up your system for Windows 95 by optimizing your hard drive and cleaning out all of the files you no longer need.

Then Norton Utilities runs in the

crash or you accidentally erase a file, Norton Utilities for Windows 95 gives you the data recovery tools users have relied on from day one.

Even if other applications crash,

### NORTON UTILITIES FOR WINDOWS 95

#### PRE-INSTALLATION TUNE-UP

*Frees up disk space and provides a comprehensive pre-installation physical.*

#### NORTON SYSTEM DOCTOR

*Continuously monitors all vital resources and data integrity. Alerts you to impending disaster and recommends action or fixes problems automatically.*

#### NORTON DISK DOCTOR®

*Automatically diagnoses and repairs file system problems using the speed and safety of 32-bit technology.*

#### UNERASE®

*100% protection of erased files. The new wizard-like interface leads you through file recovery step by step.*

#### SYSTEM INFORMATION

*Diagnoses potential conflicts and configuration problems with detailed system information and performance testing.*

#### NORTON SPEED DISK™

*Automatically optimizes drives and reduces future fragmentation using 32-bit technology.*



continuous, real-time protection and data recovery in the brave new world of Windows 95.

### PROTECT YOUR DATA FROM DAY ONE.

And like every software product from Symantec, Norton Utilities for Windows 95 comes with a full sixty-day money-back guarantee.

So you've got nothing to lose. Except your data. Get your trade-up edition of Norton Utilities for Windows 95 today.

.....  
If you own Norton Utilities, Norton Desktop for Windows or PC Tools, get your \$59.95 trade-up edition\* of Norton Utilities for Windows 95 today. To purchase, visit your software store or call us at 1-800-450-9760, ext. 9AP5.  
.....



## SYMANTEC®

\*Trade-up editions will run only when specified Symantec and Central Point products are already installed. Check with your software store for qualifying versions. Price does not include shipping & handling or any applicable sales tax. Symantec, Norton Utilities, Norton Disk Doctor and UnErase are registered trademarks and Speed Disk is a trademark of Symantec. All other brand names or trademarks are the property of their respective owners. ©1995 Symantec Corporation. All rights reserved. Visit us on the Internet at <http://www.symantec.com>. In Canada, call 1-800-365-8641. In Australia, call 2-879-6577. In Europe, call 31-71-353111.

Circle 347 on Inquiry Card.



(at higher data rates than when using a modem) to providing enhanced connections of LANs at different sites (see the figure "Remote LAN Access Examples" on page 42). In this situation, you establish connections on an as-needed basis rather than having to pay for an idle pipeline, as with a leased line. Also, the call setup time for ISDN can happen in milliseconds, which avoids unnecessary charges.

Traditional modems establish as-needed connections, but modems must convert digital data into analog signals for sending over phone lines. The ISDN difference is that every step of the communication is digital. Basic Rate Interface, or BRI, is the baseline ISDN service. It offers two B (bearer) channels of 64 Kbps each for combined throughput of 128 Kbps. (Primary Rate Interface, or PRI, offers 23 B channels.)

ISDN is a multiple-channel service with built-in packet capability, lending itself extremely well to WAN access. Unfortunately, ISDN's benefits don't always come

easily or inexpensively. Ordering ISDN service can be a nightmare. Some regional phone companies are still developing expertise with the technology, and you have to make sure the service you receive

matches the requirements of your ISDN hardware (for details on these two issues, see "Implementing ISDN," April BYTE).

You may also find that ISDN rates in your area vary widely with what a branch office is quoted in another part of the country. Service prices vary depending on which ISDN service provider you use and if you are charged a flat rate or your usage is metered. You'll also pay different rates for all-day or off-peak service. Expect baseline costs to run from \$20 to about \$70 per month for BRI. On top of this, some Regional Bell Operating Companies charge an onerous extra fee just for the privilege of running local data over ISDN. (Some network administrators sarcastically refer to this as the ISDN Data Penalty.)

On the bright side, prices for hardware are going down. Until recently, digital WAN devices were very expensive, costing more than \$15,000 per location. But now, stand-alone ISDN bridges, supporting a number of remote

## Typical Configuration of a Hub Site ISDN Bridge

Configuration parameters:		
Switch type	5ESS	Set up for AT&T 5ESS switch using custom translators
ISDN type	Custom	
Callback	OFF	Callback of remote user is off
Line speed	64K/line	
Protocol	COMPRESSED	Compression is turned on
Address age time	1000	Toss addresses older than 1000 seconds
Connection type	Auto on	Automatically call the remote user
Packet time-out	OFF	If call is unsuccessful, try recalling remote user every 30 seconds
Retry delay	30	
Called number	2935555	Remote bridge number
Ringback number		
Security parameters:		
Access status	ON	Remote users can access the device
System password	Exists	
Client password	None	
Callback security	OFF	
Remote configuration	PROTECTED	Device configuration is password-protected
Protocol filtering:		
C806	ACCEPT	Pass these Ethernet protocol types to the remote user; filter all other protocols
809b	ACCEPT	
80f3	ACCEPT	
Type of forwarding mode is	ONLY	
Type of demand mode is	ANY	
Number of Ethernet addresses:	20	Bridge knows about 20 current Ethernet addresses

## COMPARING ACCESS TECHNOLOGIES

TECHNOLOGY	SPEED	MONTHLY SERVICE COST	PROS	CONS
POTS/V.34 Modem	28.8 Kbps	— <sup>1</sup>	<ul style="list-style-type: none"> <li>Worldwide network and proven technology</li> <li>Ready availability for mobile workers</li> <li>Relatively low cost for small transmissions</li> </ul>	<ul style="list-style-type: none"> <li>Slow speed</li> <li>Poor line quality can slow transmissions</li> </ul>
T-1	1.5 Mbps	\$16,925 <sup>2</sup>	<ul style="list-style-type: none"> <li>Well-established technology</li> <li>Widely available</li> <li>High bandwidth for full-time connections</li> </ul>	<ul style="list-style-type: none"> <li>Flat-rate charges mean you pay even when you're not using the connection</li> <li>Moving or adding connections requires work orders</li> </ul>
Switched 56	56 Kbps	\$1585 <sup>2</sup>	<ul style="list-style-type: none"> <li>Relatively fast digital service</li> </ul>	<ul style="list-style-type: none"> <li>Costs can be uneconomical for low-traffic operations</li> </ul>
ISDN (BRI)	128 Kbps	\$350 <sup>3</sup>	<ul style="list-style-type: none"> <li>Fast digital connections can handle data, voice, video</li> <li>Increasing availability</li> </ul>	<ul style="list-style-type: none"> <li>Surcharges can be exorbitant</li> <li>Not available everywhere</li> </ul>
Frame Relay	2 Mbps	\$25,943 <sup>2</sup>	<ul style="list-style-type: none"> <li>High bandwidth</li> <li>Packets can shrink or grow to match file sizes</li> </ul>	<ul style="list-style-type: none"> <li>Service can be expensive</li> <li>Connections to LANs require routers</li> </ul>
ATM	622 Mbps	\$34,650 <sup>2</sup>	<ul style="list-style-type: none"> <li>High, scalable bandwidth</li> <li>Can handle data, voice, video</li> </ul>	<ul style="list-style-type: none"> <li>Products, services not yet readily available</li> </ul>

<sup>1</sup> Pricing is too variable to estimate.

<sup>2</sup> Prices based on a star topology network used by main headquarters with five branch offices. Source: TeleChoice Inc.

<sup>3</sup> Estimate for basic connection between a headquarters and five branch offices; does not include transmission costs or surcharges.



**W**indows 95 is here. And it's really terrific.

Except for one thing: it doesn't include any anti-virus protection. And your old anti-virus software won't work in Windows 95 either. But thousands of old viruses will.

So that leaves you with a choice. Do nothing and hope you never come across an infected floppy or download an infected file. Or buy a new anti-virus software product that

from the viruses everybody already knows about. But also from the new viruses created every day.

What's more, you get all this ironclad



## DETECTION, PREVENTION, DESTRUCTION. IF YOUR ANTI-VIRUS SOFTWARE DOESN'T HAVE ALL THREE, YOU'LL BE COMPLETELY EXPOSED TO VIRUSES IN WINDOWS 95.

can work in this new environment.

But which anti-virus product should you buy? Norton AntiVirus® for Windows 95.

### NCSA CERTIFIED SO YOU CAN REST EASY.

Norton AntiVirus for Windows 95 is NCSA certified to detect 100% of the viruses found in circulation. And recent independent tests\* conclusively demonstrate that Norton AntiVirus for Windows 95 detects and destroys as many or more known viruses as any other anti-virus product around.

But our virus protection doesn't stop there.

Norton AntiVirus for Windows 95 also protects you from new, unknown viruses. Thanks to a unique virus detection technology that allows us to spot any suspicious activity, no matter where it's lurking.

So your system is safe. Not just

protection without a host of long annoying disruptions to your work.

Because Norton AntiVirus for Windows 95 scans files fast. Even compressed files.

And Norton AntiVirus works in the background, continuously monitoring file access and usage. So it can stop viruses in their tracks. Which means you don't have to

worry every time you put a floppy in your disk drive.

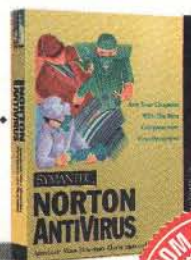
### THE NO RISK ANTI-VIRUS SOLUTION.

Needless to say, Norton AntiVirus for Windows 95 comes with our standard sixty-day money-back guarantee.

So why gamble on running Windows 95 without complete virus protection? Get your trade-up edition of Norton AntiVirus for Windows 95 today.

### TRADE-UP EDITION NOW ON SALE.

If you own Norton AntiVirus, Central Point Anti-Virus, Norton Desktop for Windows, or PC Tools, get your \$29.95 trade-up edition\*\* of Norton AntiVirus for Windows 95 today. McAfee VirusScan and Dr. Solomon's Anti-Virus owners also eligible. To purchase, visit your software store or call us at 1-800-450-9760 ext. 9AP6.



### NORTON ANTI-VIRUS FOR WINDOWS 95

WINDOWS 95 COMPLIANT  
Full 32-bit application. Supports long file names and Universal Naming Conventions.

AUTOMATIC  
BACKGROUND MONITORING  
Virtual device driver unobtrusively checks for viruses in the background. Ensures backups and files transferred are virus-free.

FAST SCANNING  
Provides ironclad virus protection without affecting productivity. Scans even compressed files fast.

EXCLUSIVE VIRUS SENSOR  
Provides continuous, transparent protection against new, unknown viruses.

NCSA CERTIFIED  
Detects 100% of viruses found in circulation.



## SYMANTEC.

\*Independent tests conducted by NCSA and VSUM, July 1995. \*\*Trade-up editions will run only when specified Symantec, Central Point, McAfee or Dr. Solomon's products are already installed. Check with your software store for qualifying versions. Price does not include shipping & handling or any applicable sales tax. Symantec and Norton AntiVirus are registered trademarks of Symantec Corporation. All other brand names or trademarks are the property of their respective owners. ©1995 Symantec Corporation. All rights reserved. Visit us on the Internet at <http://www.symantec.com>. In Canada, call 1-800-365-8641. In Australia, call 2-879-6577. In Europe, call 31-71-353111.

Circle 348 on Inquiry Card.



workstations, are available for less than \$2000. Single-workstation network devices, in the form of stand-alone units, typically sell for less than \$750. The price tag for an internal ISDN bus card can be as low as \$250. That's comparable to some high-speed modems; however, an ISDN card offers significantly better throughput than even the fastest modem.

ISDN PC cards—from companies such as DiGi International, ISDN\*Tek, and others—act like a standard network interface card, which simplifies the network connection to a single RJ-45 cable plugged into the back of the user's computer. Some external and internal devices even contain the network terminator (also known as NT-1) required with ISDN lines. This can save money, and it can also make installation considerably easier.

Along with single-user and multiuser remote devices, there is a crop of multi-ple-channel ISDN WAN hubs designed for use on the enterprise backbone. Hub devices support a number of remote users

through multiple BRI or PRI connections, or a combination of both. Hub units that can serve 160 simultaneous users cost in the \$6000 to \$12,000 range. These units are ideal for variable-load WAN environments. A hub site ISDN bridge can be configured to filter packets and compress data so that the link performance is optimized (see the table "Typical Configuration of a Hub Site ISDN Bridge" on page 44). These bridges can dial back a user for security purposes, and they can save money by consolidating phone charges and getting a volume discount for calls originating from the central site.

### Digital Alternatives

ISDN isn't the only digital game going (see the table "Comparing Access Technologies" on page 44). ATM handles traditional and multimedia data at throughput speeds that scale from 50 Mbps to 622 Mbps. This cell-switched technology breaks up data into neat 53-byte chunks at the sender. Each chunk carries the des-

tinuation address and is free to choose the path across the WAN that's quickest to the intended receiver. Once all the chunks arrive, the receiver reassembles the data into its original form.

In time, ATM may be the technology that visually links remote sites via video-conferencing. While promising as a WAN technology, the commercial market for ATM remains nascent. In addition, ATM standards, including those that define how the technology will work with current network protocols, are still being developed. ATM should certainly be on your list of strategic technologies for the future, but to get actual work done now, rely on more traditional technologies.

Switched 56, another digital WAN option, can provide dial-up connections with up to 24 simultaneous channels. You'll need to install a CSU/DSU (channel service unit/data service unit) or a special modem, but call connection times are only a couple seconds, and throughput rates max out at 1.5 Mbps.

Frame relay is a packet-switched technology related to X.25. The difference is that frame relay jettisons the error-checking capabilities of X.25 to reduce overhead and achieve speeds of 2 Mbps. Frame-relay packets can be of variable sizes to dynamically handle larger files. To transform traditional LAN packetized data into frame-relay packets, you need to connect a router, bridge, or FRAD (frame-relay access device) to your local network. Pricing for frame-relay service varies depending on the number and the line speeds of the access points you set up on your network. Pricing may be a flat rate or it may be based on usage. Costs may run \$500 a month or more.

### Don't Dis Modems

Digital technologies may be the flashiest ways of making remote connections, but high prices and availability problems can dull their luster. You may never think of POTS (plain old telephone system) as being flashy, but for ubiquitous service, fast connections for mobile workers, and low costs for modest-size data transfers, it's hard to beat a fast modem (see the figure "How They Work" on page 48).

Today's V.34 modems offer more than top-end modem speed. The standard makes these modems more efficient than their predecessors ever were. For example, V.34 devices can monitor line conditions throughout the duration of a connection, not just in the beginning. This means that a V.34 modem can slow down or speed up to match changes in line quality. Poor quality can lead to an initial connection of

## STRANGER DANGER

**As more people gain access to the enterprise, the risk to network security increases, and WAN administrators must constantly strike a balance between connectivity and security. No security measure is foolproof, but there are steps you can take to minimize the risks.**

As a rule, digital technologies are more secure than analog. Much to the chagrin of some federal agencies, the emergence of digital telecommunications technology has thwarted standard wire-tapping techniques. Recently, the FBI expressed frustration at its inability to tap ISDN circuits.

Given time, there is little doubt that the FBI, and others perhaps less honorable, will develop methods to trap digital data. Meanwhile, corporate data running over digital links remains relatively secure.

ISDN has additional security available through ICLID (Incoming Caller IDentification). With ISDN, call setup messages contain the numbers of the calling and called parties. Network devices can be programmed to check the ICLID and reject connection attempts from unauthorized telephone numbers. LAN administrators must realize that ICLID information only indicates that the correct line is being used—it does not validate the user.

No matter what security measures are inherent in the technology you choose, continue

to take more mundane defenses seriously. Passwords are a good first line of defense for keeping unauthorized remote users away from network services. However, password protection should be used only in combination with other security measures.

Authentication, based on Kerberos or internal codes created in WAN devices, is also valuable for WAN security.

Callbacks are another popular form of security for both analog and digital services. The user calls in, is validated, and is disconnected. The network then calls back the validated user. Besides providing security, callbacks can be a helpful tool for billing purposes.

There is also the possibility of unauthorized access through a telecommuter's workstation. The solutions here are much the same as those for the corporate environment. The workstation can be password-protected. Automatic log-ins should be prohibited.

Restricting physical access to the workstation at home is more difficult than in the office, but it can be done.



**C**ongratulations! You're the proud owner of Microsoft's Windows 95 operating system. Working on a PC has never been easier.

Now try these ten easy exercises and see how you can work even better and faster in Windows 95 with the all-new Norton Navigator.™

**5.** Try a word search for "profits" or any other text string within files. It's at least ten times faster on average with Norton Navigator. No matter how many files you have. Or how big they are. In fact, the bigger the files, the more time you'll save.

**6.** Save another minute every time you delete, move, zip, or encrypt from

**9.** With Norton Navigator, you can create a different desktop for each project. So you can find your work more easily. And save even more time.

**10.** Windows 95 supports long file names for all of your new 32-bit applications. Norton Navigator supports long file names



Navigator supports long file names

## THE TOP 10 REASONS WHY NORTON NAVIGATOR USERS WORK FASTER IN WINDOWS 95.

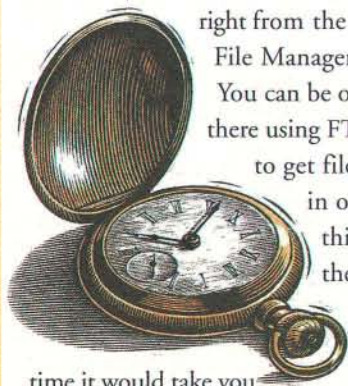
Mission accomplished. One step.

**2.** Opening a folder in Windows 95 takes a full five clicks of your trusty mouse. But with Norton Navigator, you can open any folder with just one simple click.



**3.** Compress a file. Our built-in PK-Zip compatible compression saves you a minute every time.

**4.** Use Norton Navigator to plug into your Internet connection right from the File Manager. You can be out there using FTP to get files in one third the



time it would take you with a separate application.

any application's Open or Save dialog box. (Are you keeping count?)

**7.** One click is all it takes to access recently opened files or folders from any application. Now isn't that better than wading through folders?

**8.** Launch your favorite files, folders, or applications simply by pushing a button on the Norton Taskbar. No more going up and down to and from the Start menu over and over again.



### NORTON NAVIGATOR FOR WINDOWS 95

NORTON NAVIGATOR ACCELERATES YOUR FILE MANAGEMENT IN WINDOWS 95.

*Norton Navigator puts file management at your fingertips with Norton File Manager, Explorer Extension and FileAssist.*

*Norton Folder Navigator lets you open, copy, move or create a shortcut for any folder with just one mouse click.*

*Norton Taskbar features multiple desktops that let you organize your files and find your work faster.*

*Norton FastFind performs specific text string searches at least ten times faster than Windows 95.*



for most 16-bit applications, too. So you'll never again have to remember what "billbox" means.

### MAKE WINDOWS 95 AN EVEN BETTER PLACE TO BE.

Well, there you have it. Our Top Ten. But try Norton Navigator for yourself and we're sure you'll find your own favorites. Because one of the greatest things about Norton Navigator is it lets you work the way you want to work. Needless to say, it comes with our standard 60-day money-back guarantee. So get your trade-up edition today.

.....  
If you own Norton Desktop, PC Tools, XTree, or Norton Commander, get your \$39.95 trade-up edition of Norton Navigator for Windows 95 today. To purchase, visit your software store or call us at 1-800-450-9760 ext. 9AP7.  
.....



## SYMANTEC.

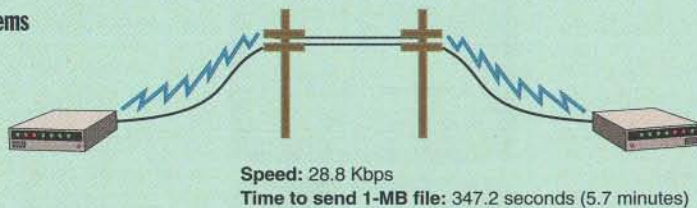
\*Trade-up editions will run only when specified Symantec and Central Point products are already installed. Check with your software store for qualifying versions. Price does not include shipping & handling or any applicable sales tax. Symantec is a registered trademark and Norton Navigator is a trademark of Symantec Corporation. All other brand names or trademarks are the property of their respective owners. ©1995 Symantec Corporation. All rights reserved. Visit us on the Internet at <http://www.symantec.com>. In Canada, call 1-800-365-8641. In Australia, call 2-879-6577. In Europe, call 31-71-353111.

Circle 349 on Inquiry Card.

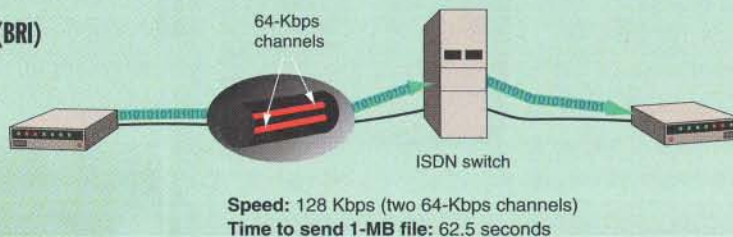


## How They Work

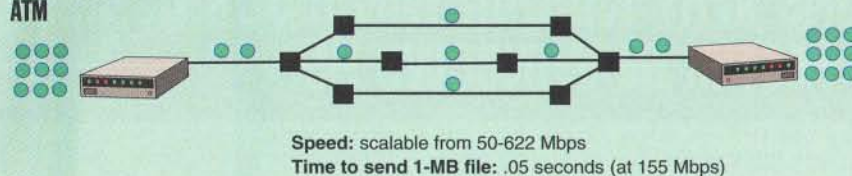
### Modems



### ISDN (BRI)



### ATM



### TRANSPORT MECHANISMS

**Analog signal** over traditional telephone networks; circuit-switched (a connection is established between two sites for the duration of the transmission).

**Digital signal** over phone network; circuit-switched.

**Digital signal** over packet-switched network. Sender breaks data up into 53-byte cells. Each cell finds fastest route to the receiver. The receiver reassembles the data into its original form.

These tools allow network technicians to administer and upgrade devices without traveling to the remote site. Using SNMP or Telnet, network managers can monitor and configure remote devices from the network control center. Similarly, TFTP allows managers to install software upgrades over the network. These tools help immensely when the remote device is hundreds of miles away from the enterprise network.

Also keep in mind that bandwidth does not buy you everything. Adequate bandwidth will help remote users feel comfortable accessing their corporate

less than 28.8 Kbps, but if quality improves during a transmission, a V.34 unit reacts by boosting throughput. Likewise, it can drop back to slower speeds if quality dissolves. Earlier modems connected at slower speeds or even broke the connection.

Using protocols such as SLIP and PPP, modems can give remote users access to local networks. By specifying how data is encapsulated before it traverses a WAN, PPP provides a standard way for modems and servers to communicate, no matter if they're running Windows, Unix, the Mac OS, or OS/2.

In addition to traditional single-user modems, some vendors, such as Microcom and Shiva, offer network modems that have been designed with remote access in mind. For example, Shiva's NetModem/E is a V.34 modem designed for dial-in connections and for connecting LANs. The company's LANRover/2E Plus is a router for remote-access applications; it uses a V.34 modem and ISDN module.

While modems provide an economical way to dial into a LAN, even 28.8 Kbps can seem slow if you're transmitting large files. Modem manufacturers have become adept at incorporat-

ing compression algorithms into their products. However, there remains a throughput ceiling above which analog services cannot go.

Nevertheless, modems will simply be the only way to provide enterprise access to a significant number of remote users. Modems are particularly effective if you need a roving link, or if you want to connect remote workers who need only E-mail or who occasionally upload or download files. Modems won't blind you with their speed, but they use time-proven technology and they're readily available.

### Take the Long View

As you're evaluating technologies to make your current WAN environment efficient and cost-effective, don't neglect to plan for the future. WAN connections tend to grow exponentially over time as more and more users require enterprise-wide services. As the WAN grows, the job of network management can become complex and time-consuming.

Network operators can minimize management overhead through WAN devices that support SNMP, Telnet, and TFTP (Trivial File Transfer Protocol).

network. However, access does not necessarily translate into efficient or functional usage. Don't confuse wide-area networks with wide-area services.

For a variety of reasons, WAN users might have restricted access to enterprise services. Certain file servers and printers might be unavailable to WAN users for security reasons. Remote users might have access to TCP/IP-based services, but not to NetWare or AppleTalk. Restricted services can be a cost, security, or bandwidth-conservation issue. Remote users need to understand that they will not necessarily have all the services they might be used to.

Ad hoc WANs are no longer considered some kind of far-out future computing environment. Telecommuting and remote office connections to enterprise networks are a growing reality in business today. It takes extra resources, planning, and thoughtful deployment to provide secure and efficient WAN services. However, the benefits in getting beyond the LAN outweigh the costs. ■

*Jeffrey Fritz is a telecommunications engineer who designs and manages data communications for West Virginia University, including its ISDN applications lab. Fritz chairs the National Information Infrastructure Working Group. You can contact him on the Internet at [jfritz@wvnm.wvnet.edu](mailto:jfritz@wvnm.wvnet.edu) or on BIX c/o editors.*

### Where to Find

**DiGi International Inc.**  
Eden Prairie, MN  
(612) 943-9020  
fax: (612) 943-5398

**ISDN\*Tek**  
San Gregorio, CA  
(415) 712-3000

**Microcom Inc.**  
Norwood, MA  
(617) 551-1000  
fax: (617) 551-1021

**Shiva Corp.**  
Burlington, MA  
(508) 788-3061  
fax: (508) 788-1539



# BYTE

ANNIVERSARY EDITION



# 20 YEARS

**best**  
**COMPUTERS**

P.54

**top**  
**PROGRAMS**

P.64

**biggest**  
**TECHNOLOGIES**

P.109

**most**  
**influential**  
**PEOPLE**

P.133



## The Experts recommend HASP.

"In all the products we tested, except the HASP, we could see through the encrypting and questioning procedures... and crack them."

**CT Magazine (Germany)**

"Of all the protection devices tested, [MemoHASP] is without any doubt the one which combines the best features."

**PCCompatible (Spain)**

"Trying to crack a program... that was protected utilizing all of HASP's features is like searching for the Holy Grail."

**Micro Systems (France)**

"PC dongles... come with varying claims as to their transparency. The majority suffer from problems when a printer is connected... the HASP-3 is not affected...."

**Program Now (Britain)**

"Of all keys tested, HASP is the most ambitious one... the quality of HASP manufacturing seems excellent."

**PC Compatible (France)**

"[MacHASP is] an easy to use software protection system for the Macintosh, which ensures an effective defense against software piracy... Life is difficult for pirates... MacHASP is an optimal protection method, for the programmers... and for the users...."

**Bit Magazine (Italy)**

## Our Clients agree.

"Aladdin's HASP has helped us increase our revenues by providing us with extremely reliable and user-friendly protection for our software. In addition, Aladdin's service and technical support are simply first class."

**Frank LaMonica, Chairman,  
Vibrant Graphics**

"Quark/QSS has chosen HASP and MacHASP to protect QuarkXpress® in our most demanding markets, because we believe that Aladdin's products meet the high standards of reliability, compatibility and security required for these markets."

**John MacMonagle, Purchasing Manager,  
Quark/QSS**

"Aladdin's HASP gives our customers the key to protecting their investment in software development."

**David Assia, CEO,  
Magic Software Enterprises Ltd.**



MacHASP™ - The Professional Software Protection System for the Macintosh

"We have been most impressed with the quality of the HASP keys, as well as with the excellent support provided by Aladdin. We have tried a number of protection methods, but for ease-of-use, cost, and reliability, we keep coming back to HASP."

**Jeremy du Plessis, Director,  
Indexia Research**

## Operating Environments

**PC:** DOS, Windows, Windows NT, Win32s, Windows 95, OS/2, SCO Unix, SCO Xenix, Interactive Unix, AIX, AutoCAD, DOS Extenders, LANs

**MAC:** Mac, Power Mac, LANs (ADB port)

**NEC:** DOS, Windows, Windows NT, LANs

**OPEN SYSTEMS:** RS6000, Sun, HP, DEC Alpha, Silicon Graphics, and more.

**AMIGA**

**Visit Our Web Site!**

<http://www.hasp.com/>

1985-1995



**1-800-223-4277**

**ALADDIN**

*The Professional's Choice*

**North  
America**

**Aladdin Software Security Inc.**  
Tel: (800) 223 4277, 212-564 5678  
Fax: 212-564 3377  
E-mail: sales@hasp.com  
WWW: http://www.hasp.com/

**Intl Office**

**Aladdin Knowledge Systems Ltd.**  
Tel: 972-5-537 5795, Fax: 972-5-537 5796  
E-mail: aladdinuk@solo.pipex.com

**United  
Kingdom**

**Aladdin Knowledge  
Systems UK Ltd.**  
Tel: 01753-622266, Fax: 01753-622262  
E-mail: aladdinuk@solo.pipex.com

**France**

**Aladdin France SA**  
Tel: 1 40 85 98 85, Fax: 1 41 21 90 56  
Compuserve: 100622,1522

■ Aladdin Benelux 08894 19777 ■ Aladdin Japan 0426 60 7191 ■ Aladdin Russia 095 9230588 ■ Australia Conlab 3 98985685 ■ Czech Atlas 2 766085  
■ Chile Micrologica 2 222 1388 ■ Denmark Berendsen 39 577300 ■ Egypt Zeineldein 2 3604632 ■ Finland ID-Systems 0 870 3520 ■ Germany CSS 201 278804  
■ Greece Unibrain 1 6856320 ■ India Solutions 11 2218254 ■ Italy Partner Data 2 26147380 ■ Korea Dae-A 2 848 4481 ■ Mexico SiSoft 5 5439770  
■ New Zealand Training 4 5666014 ■ Poland Systherm 61 480273 ■ Portugal Futurmatca 1 4116269 ■ Romania Interactiv 64 153112  
■ South Africa D Le Roux 11 686 4704 ■ Spain PC Hardware 3 4493193 ■ Switzerland Opag 61 7169222 ■ Taiwan Teco 2 555 9676 ■ Turkey Mikrobeta 312 467 7504

© Aladdin Knowledge Systems Ltd. 1995-1995 HASP is a registered trademark of Aladdin Knowledge Systems Ltd. All other product names are trademarks of their respective manufacturers. Mac & the Mac OS logo are trademarks of Apple Computer, Inc., used under license.

**Circle 214 on Inquiry Card (RESELLERS: 215).**



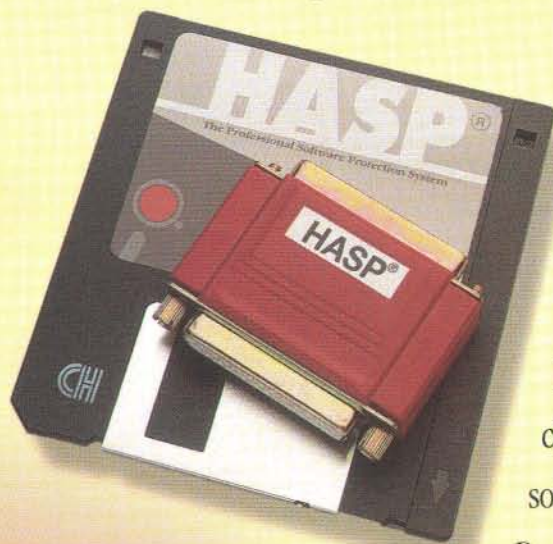
Each year, the illegal use of software consumes nearly 50% of your potential revenues. With the flames of piracy eating away at your profits, can you afford not to protect your software?

Software Obtained Illegally, by region, 1993 vs. 1994



# HASP®

## *The Professional Software Protection System*



HASP® is widely acclaimed as the world's most advanced software protection solution. Since 1984, thousands of leading developers have used over one million HASP keys to protect billions of dollars worth of software.

In fact, more developers are now choosing HASP than any other software protection method. Why?

Because HASP's security, reliability, and ease-of-use led them to a simple conclusion: HASP is the most effective software protection system available.

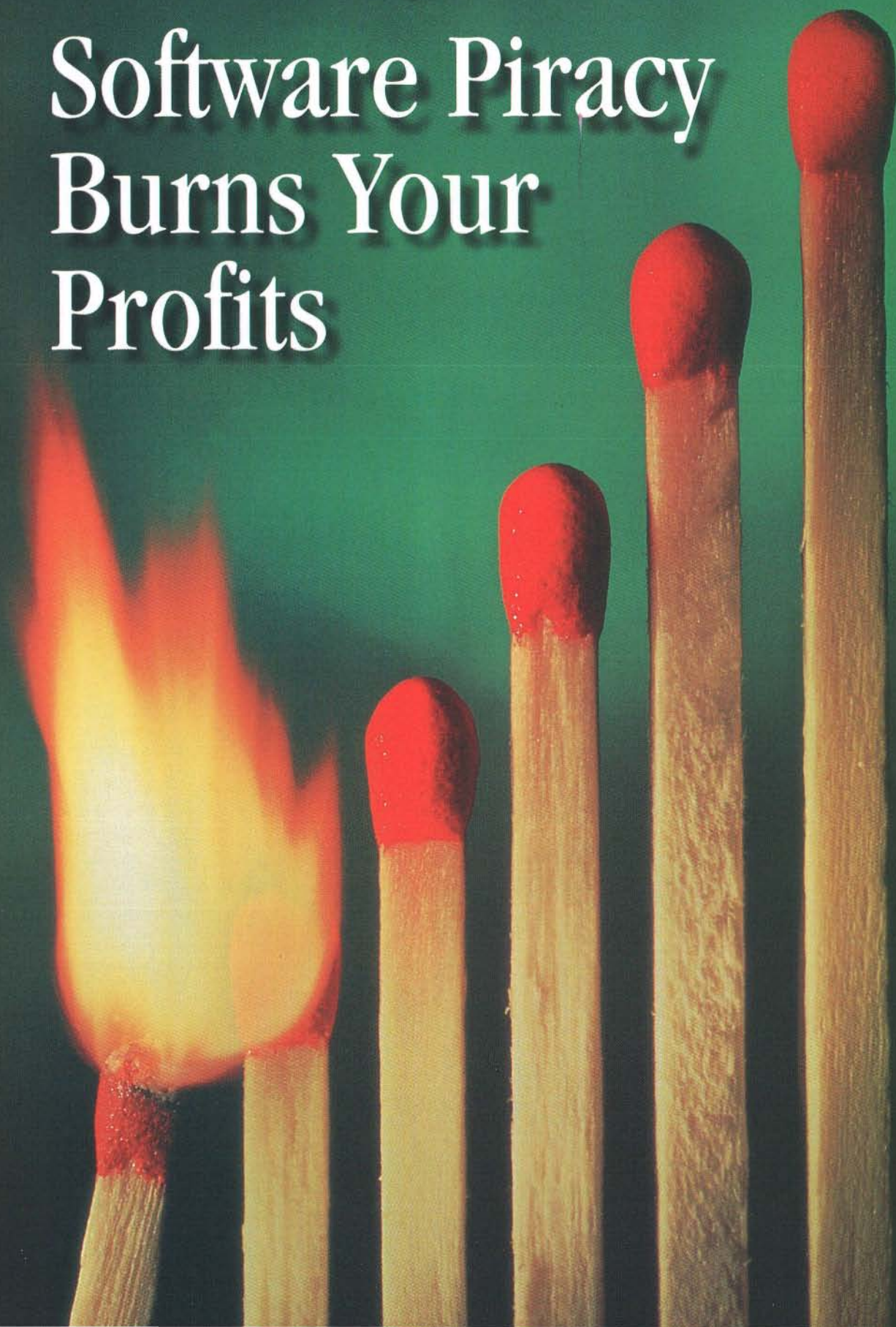
To see for yourself how easily you can increase your revenues, call 1-800-223-4277 to order your HASP Developer's Kit.





Software Developers:

# Software Piracy Burns Your Profits





# Message from the Editor in Chief

This special report marks the culmination of BYTE's twentieth year of publishing. Our magazine has changed a lot in 20 years. So has the microcomputer industry. And so has the BYTE reader.

Twenty years ago, a devoted cadre of hobbyists and home-brew computer engineers made up the readership of this magazine. We built computers with our bare hands and toggled programs via front-panel switches. A mouse was a rodent, a network was a collection of business acquaintances, and gooeey and scuzzy were undesirable attributes of decaying vegetation.

Now we're hurtling toward a future where computers are integral to all strata of business and society. In the pages of BYTE each month, we celebrate and explain our advancing technologies. We look to give

you the information you need to plan for tomorrow.

While no other group is as resolutely focused on the future as are technologists, it's valuable to look back at the people and achievements that have put us where we are now. Today's technology has evolved from the creative imagination of a core group of visionaries, realized in their companies, their products, and their successes and failures.

This special report is a nostalgia trip; it puts us in the crotchety-old-man role of saying, "Yep, Sonny, I remember when 64 KB was all the memory we'd ever need." Of course, 20 years from now, we'll be peering into history yet again, laughing at the previous generation's lack of horsepower, bandwidth, and integration—and, probably, once again remembering the "old days" with a peculiar fondness.



Raphael Needleman, Editor in Chief



AS A REWARD FOR HARD WORK, WE LET THE TWENTIETH ANNIVERSARY EDITORIAL CREW OUT OF THE BUILDING. BUT ONLY FOR A MOMENT.

## CONTENTS

1	TOP 20 SMALL SYSTEMS	54
2	TOP 20 SOFTWARE PRODUCTS	64
3	TOP 20 CHIPS	74
4	TOP 20 NETWORKING PRODUCTS & STANDARDS	79
5	THE BEST THINGS ON-LINE	85
6	BEST BOOKS & CD-ROMS	91
7	REMARKABLE NAMES OF REAL COMPUTER COMPANIES	97
8	MOST IMPORTANT COMPANIES	99
9	TOP 20 TECHNOLOGIES	109
10	PREDICTIONS FOR THE YEAR 2000	110
11	20 WORST ACRONYMS	114
12	A BRIEF HISTORY OF PROGRAMMING LANGUAGES	121
13	NOTORIOUS BUGS	125
14	BEST COMPUTER SHOWS	128
15	20 CONTRIBUTIONS TO SOCIETY	131
16	20 MOST IMPORTANT PEOPLE	133
17	20 SPECTACULAR FAILURES	145
18	NOTED & NOTORIOUS HACKER FEATS	151
19	FAMOUS VAPORWARE PRODUCTS	165
20	TOP GARAGE START-UPS	165



## Top 20

## Small

## Systems

From soldering irons to SparcStations, from MITS to Macintosh, personal computers have evolved from do-it-yourself kits for electronics hobbyists into machines that practically leap out of the box and set themselves up. What enabled them to get from there to here? Innovation and determination. Here are the top 20 systems that made that rapid evolution possible.

#### ■ MITS Altair 8800

There once was a time that you could buy a top-of-the-line computer for \$395. The only catch was that you had to build it yourself. Although the Altair 8800 wasn't actually the first personal computer (Scelbi Computer Consulting's 8008-based Scelbi-8H kit probably took that honor in 1973), it grabbed attention. MITS sold 2000 of them in 1975—more than any single computer before it.

Based on Intel's 8-bit 8080 processor, the Altair 8800 kit included 256 bytes of memory (upgradable, of course) and a toggle-switch-and-LED front panel. For amenities such as keyboards, video terminals, and storage devices, you had to go to one of the companies that sprang up to support the Altair with expansion cards. In 1975, MITS offered 4- and 8-KB Altair versions of BASIC, the first product developed by Bill Gates' and Paul Allen's new company, Microsoft.

If the personal computer hobbyist movement was simmering, 1975 saw it come to a boil with the introduction of the Altair 8800.

#### ■ Apple II

Those of you who think of the IBM PC as the quintessential business computer may be in for a surprise: The Apple II (together



"ANYBODY WHO COULD WRITE A GOOD APPLICATION ON THE 128K MAC DESERVES A MEDAL."—BILL GATES



THE STORY GOES THAT THE CHAIRMAN OF IBM LOOKED AT THE ORIGINAL PC AND SAID THAT IT WOULD NEVER FLY—THAT MAINFRAMES WOULD DOMINATE FOREVER. TELL ME AGAIN WHY PEOPLE WERE BUYING STOCK IN THIS COMPANY.

with VisiCalc) was what really made people look at personal computers as business tools, not just toys.

The Apple II debuted at the first West Coast Computer Faire in San Francisco in 1977. With built-in keyboard, graphics display, eight readily accessible expansion slots, and BASIC built into ROM, the Apple II was actually easy to use. Some of its innovations, like built-in high-resolution color graphics and a high-level language with graphics commands, are still extraordinary features in desktop machines.

With a 6502 CPU, 16 KB of RAM, a 16-KB ROM, a cassette interface that never really worked well (most Apple IIs ended up with the floppy drive that was announced in 1978), and color graphics, the Apple II sold for \$1298.

#### ■ Commodore PET

Also introduced at the first West Coast Computer Faire, Commodore's PET (Personal Electronic Transactor) started a long line of inexpensive personal computers that brought computers to the masses. (The VIC-20 that followed was the first computer to sell 1 million units, and the Commodore 64 after that was the first to offer a whopping 64 KB of memory.)

The keyboard and small monochrome display both fit in the same one-piece unit. Like the Apple II, the PET ran on MOS Technology's 6502. Its \$795 price, key to the PET's popularity, supplied only 4 KB of RAM but included a built-in cassette tape drive for data storage and an 8-KB version of Microsoft BASIC in its 14-KB ROM.

#### ■ Radio Shack TRS-80

Remember the Trash 80? Sold at local Radio Shack stores in your choice of color



# ems

17  
YEARS  
AGO IN  
**BYTE**  
MAGAZINE

Scott Cook take note: We published a 37-line BASIC program for people who wanted to balance their checkbook.

Christmas shoppers wonder if they should buy one of these new Betamax VCRs.

(Mercedes Silver), the TRS-80 was the first ready-to-go computer to use Zilog's Z80 processor.

The base unit was essentially a thick keyboard with 4 KB of RAM and 4 KB of ROM (which included BASIC). An optional expansion box that connected by ribbon cable allowed for memory expansion. A Pink Pearl eraser was standard equipment to keep those ribbon cable connections clean.

Much of the first software for this system was distributed on audiocassettes played in from Radio Shack cassette recorders.

## ■ Osborne 1 Portable

By the end of the 1970s, garage start-ups were passé. Fortunately there were other entrepreneurial possibilities. Take Adam Osborne, for example. He sold Osborne Books to McGraw-Hill and started Osborne Computer. Its first product, the 24-pound Osborne 1 Portable, boasted a low price of \$1795.

More important, Osborne established the practice of bundling software—in spades. The Osborne 1 came with nearly \$1500 worth of programs: WordStar, SuperCalc, BASIC, and a slew of CP/M utilities.

Business was looking good until Osborne preannounced its next version while sitting on a warehouse full of Osborne 1s. Oops. Reorganization under Chapter 11 followed soon thereafter.

## ■ Xerox Star

This is the system that launched a thousand innovations in 1981. The work of some of the best people at Xerox PARC (Palo Alto Research Center) went into it. Several of these—the mouse and a desktop GUI with icons—showed up two years later in Apple's Lisa and Macintosh computers.

The Star wasn't what you'd call a commercial success, however. The main problem seemed to be how much it cost. It would be nice to believe that someone shifted a decimal point somewhere: The pricing started at \$50,000.

## ■ IBM PC

Irony of ironies that someone at mainframe-centric IBM recognized the business potential in personal computers. The result was the 1981 landmark announcement of the IBM PC. Thanks to an open architecture, IBM's clout, and Lotus 1-2-3 (announced one year later), the PC and its progeny made business micros legitimate and transformed the personal computer world.

The PC used Intel's 16-bit 8088, and for \$3000, it came with 64 KB of RAM and a 5¼-inch floppy drive. The printer adapter and monochrome monitor were extras, as was the color graphics adapter.

## ■ Compaq Portable

Compaq's Portable almost single-handedly created the PC clone market. Although that was about all you could do with it single-handedly—it weighed a ton. Columbia Data Products just preceded Compaq that year with the first true IBM PC clone but didn't survive. It was Compaq's quickly gained reputation for engineering and quality, and its essentially 100 percent IBM compatibility (reverse-engineered, of course), that legitimized the clone market. But was it really designed on a napkin?

## ■ Radio Shack TRS-80 Model 100

Years before PC-compatible subnotebook computers, Radio Shack came out with a book-size portable with a combination of features, battery life, weight, and price that

## Five Peripherals the PC Revolution Couldn't Do Without

### 1) SHUGART 5¼-INCH FLOPPY DRIVE

Before PC hard drives were available, the floppy drive was the "mass" storage medium of choice. It killed paper tapes and audiocassettes.

### 2) EPSON MX-80

Fast and inexpensive, and it could also do graphics (with a later upgrade). What good is a spreadsheet chart if you can't print it out? The competing daisy wheel's advantage was typewriter text clarity.

### 3) SEAGATE 5¼-INCH 5-MB WINCHESTER HARD DRIVE

Now this was mass storage that could fit in a PC—once the price came down. Alan Shugart was involved here, too.

### 4) HAYES SMARTMODEM 300

The modem that launched the industry-standard AT command set.

### 5) HEWLETT-PACKARD LASERJET

Graphics, speed, and sharp text for less than \$2000, thanks to Canon's 300-dpi laser engine. Using the same engine, Apple came out with its LaserWriter shortly thereafter.

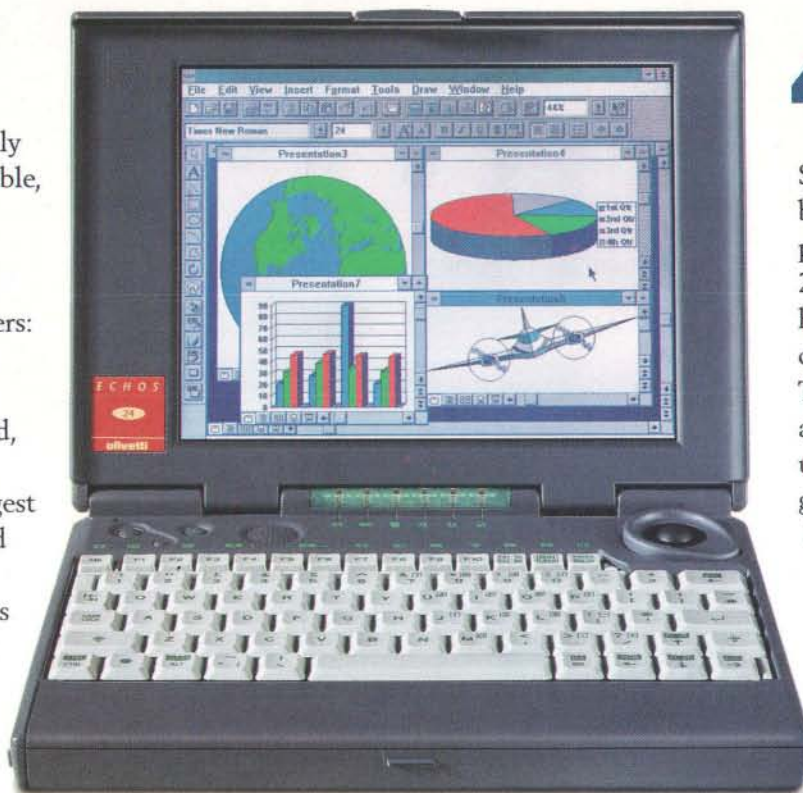


## Olivetti Echos 20 Series

# Before choosing an ultralight portable PC, count to ten.

### THE 1.8-KG COLOUR PORTABLE

Echos 24 is a truly ultralight colour portable, weighing in at only 1.8 kg. Its compact dimensions are best expressed in millimeters: 264 x 190 x 38. Just wide enough not to skimp on the keyboard, just deep enough to mount one of the biggest screens in its class, and just thick enough to contain all the features you need. And Echos 20 with monochrome screen is even slimmer: only 35 mm.



### 4 9.4-INCH DSTN COLOUR DISPLAY

Some things just cannot be miniaturised (e.g. your presentations), so Echos 24 has a new generation high-contrast 9.4" DSTN colour display.

This excellent screen is among the biggest in the ultralight class, and is bigger than many found on heavier and costlier portables. A Vesa local bus and new Fast IDE interface interact to elaborate graphics in 256 colours with surprising speed.

### 2 HEAVYWEIGHT PERFORMANCE

This ruggedly elegant little package outperforms many bulkier machines. Your graphics really move thanks to a Fast IDE interface and Vesa local bus, and Echos 24's 4 MB of RAM easily expand to 20 MB. With HDU ranging from 260 to 340 MB and top-performing Intel DX2/50 CPUs, Echos 24 is a no-compromise solution for your business.



### 3 LOW CONSUMPTION 3.3-VOLT CIRCUITRY

Unlike most portables, Olivetti Echos 24 employs energy efficient 3.3-Volt circuitry for its CPU, chipset and memory. That means Echos 24 can sustain 3 1/4 consecutive hours of intensive use (run-down test with NiMH battery). Its APM-compliant power management system is so efficient that it can stay in suspend mode for 143 hours - almost 6 days - with no risk to your data.

### 5 PLUG AND PLAY EASE

A Phoenix plug and play driver ensures that Echos 24 instantly recognises a vast array of PCMCIA cards. Olivetti

#### PCMCIA type III slot





has also equipped these ultralights with print drivers for more than 50 major types of printers, so you can print easily using almost anyone's printer without re-configuring. Other user-friendly touches include a battery life icon that's always visible and on-line User Manuals.

## 6 FULL-SIZED KEYBOARD

Olivetti has exploited every available millimeter of width in giving you a keyboard that won't cramp your style. The letter and number keys are a full 17 mm on each side - like a

### Comfortable keyboard



desktop. The built-in trackball is mounted at right beneath the display in an ergonomic, flexible base which coddles your thumb as you point the cursor. There are two clicking positions, one on the right rear corner and a second opposite the trackball for left-handers.

### Ergonomic trackball



## 7 UNLIMITED FLEXIBILITY

Echos 24 imposes no limits on your productivity. The HDU is field-service upgradeable, and widely available standard SIMM RAM expansion modules of 4, 8 or 16 MB are a snap to install using only a screwdriver.

### Full connectivity



An external FDU is included, and the integrated PCMCIA Type III slot with Phoenix driver gives you universal connection availability: fax/modem, local network and host I/O, HDU enhancement, and more. Serial and parallel ports are standard, and options include port replicator, VGA adapter and infrared port.

## 8 WORK AT 10,000 FT.

That's right. You can use your Echos 24 up to a height of 3,000 meters. In addition to certifying the reliability of its components, Olivetti subjects Echos 24 to

### Ultraslim design



a battery of tests to ensure that it meets the highest standards for resistance to shock, cold, heat, pressure, humidity, radio interference, vibration, noise and, of course, altitude.

## 9 TESTED WITH HUNDREDS OF HW/SW PRODUCTS

Olivetti's commitment to

industry standards and compatibility is only fitting for a company that is the N° 1 supplier of multi-vendor service in Europe. Echos 24 is tested compatible with over 100 leading software packages and with the products of all major PCMCIA card suppliers. Use it today in the knowledge that you will be able to use it tomorrow, no matter how the I.T. market evolves.

## 10 CUSTOMER CARE

Olivetti's dedication to customer satisfaction can be seen in the two standard warranties applicable to every Echos 24, one national and one international. If your work takes you abroad, take your Echos 24. And your Echos 24 will automatically bring its guarantee. For even more peace of mind, Olivetti Service Plus offers a wide range of warranty extensions and additional services to meet your individual needs. All this is supported by Olivetti's international network of 5,500 Dealers and Systems Partners and 15,000 technical specialists.

For further information telephone:

Austria (1)816940 • Belgium (2)2299111 • Denmark (31)201000  
Finland (0)88741 • France (1)49067111 • Germany (0130)843300  
Greece (1) 9373800 • Holland (071) 319931 • Israel (3)7516879  
Italy (167)012587 • Norway 2218 6100  
• Portugal (1)3558260  
Spain (900)370370 • Sweden (8)59005200 • Switzerland (1)8391565  
Turkey (212)2750810  
U.K. (0800)447799

Intel Inside is a trademark of Intel Co.

# olivetti

Circle 516 on Inquiry Card (RESELLERS: 517).



# Top 20 Small Systems

is still unbeatable. (Of course, the Z80-based Model 100 didn't have to run Windows.)

The \$800 Model 100 had only an 8-row by 40-column reflective LCD (large at the time) but supplied ROM-based applications (including text editor, communications program, and BASIC interpreter), a built-in modem, I/O ports, nonvolatile RAM, and a great keyboard. Weighing under 4 pounds, and with a battery life measured in weeks (on four AA batteries), the Model 100 quickly became the first popular laptop, especially among journalists.

With its battery-backed RAM, the Model 100 was always in standby mode, ready to take notes, write a report, or go on-line. NEC's PC 8201 was essentially the same Kyocera-manufactured system.

## ■ Apple Macintosh

Whether you saw it as a seductive invitation to personal computing or a cop-out to wimps who were afraid of a command line, Apple's Macintosh and its GUI generated even more excitement than the IBM PC. Apple's R&D people were inspired by critical ideas from Xerox PARC (and practiced on Apple's Lisa) but added many of their own ideas to create a polished product that changed the way people use computers.

The original Macintosh used Motorola's 16-bit 68000 microprocessor. At \$2495, the system offered a built-in high-resolution monochrome display, the Mac OS, and a single-button mouse. With only 128 KB of RAM, the Mac was underpowered at first. But Apple included some key

applications that made the Macintosh immediately useful. (It was MacPaint that finally showed people what a mouse is good for.)

## ■ IBM AT

George Orwell didn't foresee the AT in 1984. Maybe it was because Big Blue, not Big Brother, was playing its cards close to its chest. The IBM AT set new standards for performance and storage capacity. Intel's blazingly fast 286 CPU running at 6 MHz and a 16-bit bus structure gave the AT several times the performance of previous IBM systems. Hard drive capacity doubled from 10 MB to 20 MB (41 MB if you installed two drives—just don't ask how they did the math), and the cost per megabyte dropped dramatically.

New 16-bit expansion slots meant new (and faster) expansion cards but maintained downward compatibility with old 8-bit cards. These hardware changes and new high-density 1.2-MB floppy drives meant a new version of PC-DOS (the dreaded 3.0).

The price for an AT with 512 KB of RAM, a serial/parallel adapter, a high-density floppy drive, and a 20-MB hard drive was well over \$5000—but much less than what the pundits expected.

## ■ Commodore Amiga 1000

The Amiga introduced the world to multimedia. Although it cost only \$1200, the 68000-based Amiga 1000 did graphics, sound, and video well enough that many broadcast professionals adopted it for special effects. Its sophisticated multimedia hardware design was complex for a personal computer, as was its multitasking, windowing OS.

## ■ Compaq Deskpro 386

While IBM was busy developing (would "wasting time on" be a better phrase?) proprietary Micro Channel PS/2 systems, clone vendors ALR and Compaq wrested away control of the x86 architecture and



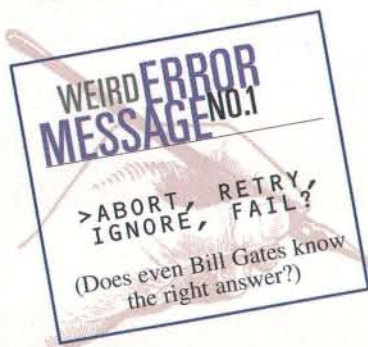
HELLO? TECHNICAL SUPPORT? I THINK I MISPLACED THE MONITOR FOR MY OSBORNE PORTABLE. IT DOES HAVE A MONITOR, DOESN'T IT? OH, THAT'S THE MONITOR.



THE APPLE II GAVE A GOOD NAME TO CLUTTERED GARAGES ALL ACROSS THE COUNTRY. AFTER ALL, YOU COULD ALWAYS SAY THAT UNDER THAT MESS LAY THE COMPONENTS FOR THE NEXT GREAT COMPUTER.

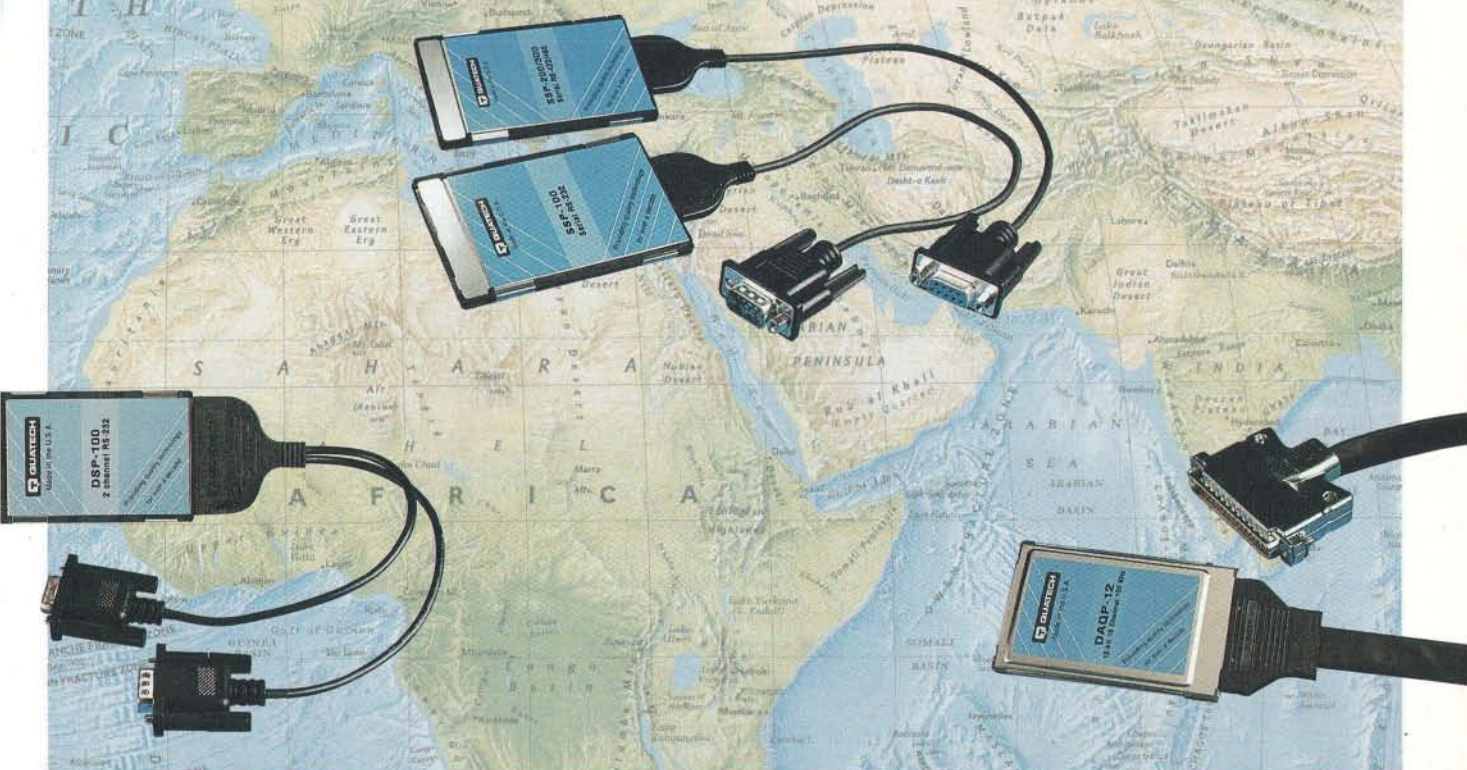


COME ON BABY, LIGHT MY FIRE. IT WASN'T TOO HARD TO DO WITH SUN'S SPARCSTATION 1 BACK IN 1989. IT WAS FAST. IT WAS CHEAP. THE ENGINEERS WHO LOVED THEM LOOKED NO FURTHER FOR A VERY LONG TIME.





# No Matter Where Your Application Takes You



## Quatech PC Cards Are There.

Quatech, Inc. manufactures a complete line of quality data acquisition and communication PC Cards made in the U.S.A. Each card is PC Card Specification 2.1 compliant and includes enabler and client driver software.

### Data Acquisition PC Cards

- 24 digital input/output card
- 12 and 16-bit analog input cards with 16 channels of programmable scanning and gain selections
- Eight channel analog output card available in unipolar and bipolar versions
- DAQDrive included, optional VisualDAQ

### Communication PC Cards

- Single and dual channel RS-232
- Single and dual channel RS-422/485
- One channel RS-232 and one channel RS-422/485
- Multi-protocol adapter supports HDLC and SDLC
- Parallel port/enhanced parallel port card
- DOS, Windows, and SCO UNIX compatible



Call 800-553-1170 today for complete information and a FREE 1995 Product Handbook.

Quatech, Inc. 662 Wolf Ledges Parkway, Akron, OH 44311. **International Distributors:** **Australia**/Interworld Electronics & Computer 61-3-95635011, **Austria**/Megadata 43-1-523 42 12, **Belgium**/Acal NV/SA 32-27-205983, **Brazil** (Sao Paulo)/Intercomp 55-11-8532733, **Brazil** (Rio de Janeiro)/Medusa Sistemas e Automacao 55-21-2554745, **Canada**(Western)/Interworld Electronics 800-663-6001(Toronto office 800-465-0164), **China**/Quatech China 86-1-205-9030, **Denmark**/Jes Rasmussen ApS. 45-4281-6838, **Finland**/Lab Hi-Tech OY 358-0-682-1255, **France**/Eleco 33-1-69537020, **Germany**/Jupiter Electronic Systems GMBH 49-61-8175041, **Hong Kong**/Brio Technology Ltd. 852-581-1111, **India**/Comsquare Network Pvt. Ltd. 91-11-224-5159, **Israel**/Milivision Ltd. Div. 972-9-500623, **Italy**(Non-PCMCIA)/N.C.S. Computer Italia 39-331-770016, **Italy**(PCMCIA Only)/Kernel Consulting S.r.l. 39-6-77207000, **Japan**/Nictrix Corp. (New Jersey) 201-947-2220, **Korea**/Sam Boo Systems 82-2-5384001, **Netherlands**/ACAL Auriema 31-40-502602, **New Zealand**/Advanced Portable Technologies 64-4-3852838, **Pakistan**/Rastek (PVT) Limited 92-21-4551881, **Saudi Arabia**/Integrated Computer Operations 966-3-895-1827, **Singapore**/Bliss Services Pte Ltd. 65-338-1300, **South Africa**/Eagle Technology 27-21-234943, **Spain**/Santa Barbara SA 34-3-418-81-16, **Sweden**/Systec 46-13-310140, **Switzerland**/Technosoft 41-64-519040, **Turkey**/Logic Group 90-212-2747197

Circle 241 on Inquiry Card (RESELLERS: 242).



# Top 20 Small Systems

introduced the first 386-based systems, the Access 386 and the Deskpro 386. Both systems maintained backward compatibility with the 286-based AT.

Compaq's Deskpro 386 had a further performance innovation in its Flex bus architecture. Compaq split the x86 external bus into two separate buses: a high-speed local bus to support memory chips fast enough for the 16-MHz 386, and a slower I/O bus that supported existing expansion cards.

## ■ Apple Macintosh II

When you first looked at the Macintosh II, you may have said, "But it looks just like a PC." You'd have been right. Apple decided it was wiser to give users a case they could open so they could upgrade it themselves. The monitor in this 68020-powered machine was a separate unit that typically sat on top of the CPU case.

## ■ Next Nextstation

Unix had never been this easy to use, and only now, 10 years later, are we getting back to that level. Unfortunately, Steve Jobs' cube never developed the software base it needed for long-term survival. Nonetheless, it served as an inspiration for future workstations.

Priced at less than \$10,000, the elegant Nextstation came with a 25-MHz 68030 CPU, a 68882 FPU, 8 MB of RAM, and the first commercial magneto-optical drive (256-MB capacity). It also had a built-in DSP (digital signal processor). The programming language was object-oriented C, and the OS was a version of Unix, sugarcoated with a consistent GUI that rivaled Apple's.

## ■ NEC UltraLite

NEC's UltraLite is the portable that put *subnotebook* into the lexicon. Like Radio Shack's TRS-80 Model 100, the UltraLite was a 4-pounder ahead of its time. Unlike the Model 100, it was expensive (starting price, \$2999), but it could run MS-DOS. (The burden of running Windows wasn't

yet thrust upon its shoulders.)

Fans liked the 4.4-pound UltraLite for its trim size and portability, but it really needed one of today's tiny hard drives. It used battery-backed DRAM (1 MB, expandable to 2 MB) for storage, with ROM-based Traveling Software's LapLink to move stored data to a desktop PC.

Foreshadowing PCMCIA, the UltraLite had a socket that accepted credit-card-size ROM cards holding popular applications like WordPerfect or Lotus 1-2-3, or a battery-backed 256-KB RAM card.

## ■ Sun SparcStation 1

It wasn't the first RISC workstation, nor even the first Sun system to use Sun's new SPARC chip. But the SparcStation 1 set a new standard for price/performance, churning out 12.5 MIPS at a starting price of only \$8995—about what you might spend for a fully configured Macintosh. Sun sold lots of systems and made the words *SparcStation* and *workstation* synonymous in many people's minds.

The SparcStation 1 also introduced S-Bus, Sun's proprietary 32-bit synchronous bus, which ran at the same 20-MHz speed as the CPU.

## ■ IBM RS/6000

Sometimes, when IBM decides to do something, it does it right. (Other times... Well, remember the PC jr.?) The RS/6000 allowed IBM to enter the workstation market. The RS/6000's RISC processor chip set (RIOS) racked up speed records and introduced many to the term *superscalar*. But its price was more than competitive. IBM pushed third-party software support, and as a result, many desktop publishing, CAD, and scientific applications ported to the RS/6000, running under AIX, IBM's Unix.

A shrunken version of the multichip RS/6000 architecture serves as the basis for the single-chip PowerPC, the non-x86-compatible processor with the best chance of competing with Intel.



COMPAQ GAVE NEW MEANING TO THE WORD PORTABLE WITH THIS 20-POUND BEHEMOTH.



A 4-POUND BUNDLE OF JOY: THE TRS-80 100.



ELEVEN YEARS LATER: STILL LIVING WITH THE AT ARCHITECTURE.



PET PEEVE? SOMEONE TOOK A DESKTOP CALCULATOR AND FED IT STEROIDS FOR A YEAR TO SEE WHAT HAPPENS.

## ■ Apple Power Macintosh

Not many companies have made the transition from CISC to RISC this well. The Power Macintosh represents Apple's well-planned and successful leap to bridge two disparate hardware platforms. Older Macs run Motorola's 680x0 CISC line, which is running out of steam; the Power Macs run the PowerPC RISC chip. The new Macs run existing 680x0-based applications yet provide PowerPC performance, a combination that sold over a million systems in a year.

## ■ IBM ThinkPad 701C

It's not often anymore that a new computer inspires gee-whiz sentiment, but IBM's Butterfly subnotebook does, with its marvelous expanding keyboard. The 701C's two-part keyboard solves the last major piece in the puzzle of building a usable subnotebook: how to provide comfortable touch-typing. (OK, so the floppy drive is still external.)

With a full-size keyboard and a 10.4-inch screen, the 4.5-pound 701C compares favorably with full-size notebooks. Battery life is good, too.



# Just because

we make HP plotters so reliable doesn't mean we can't surprise you once in a while.



Now starting at  
**\$2,395**

HP DesignJet plotters are well known for their crisp, clean print quality. Are noted for their impressive speed. And, of course, are consistently applauded for their reliability, backed by a next-day, on-site service warranty. Now, with two new models, we bring you affordability. The HP DesignJet 230 offers D-size monochrome plot-

ting for only \$2,395. And for \$2,995, the HP DesignJet 250C finally puts color plotting within reach.\* For an output sample or the name of your local HP demo dealer, visit us on the World Wide Web at <http://www.hp.com/info/9553>.

Or, call 1-800-851-1170, Ext. 9553!

\*U.S. list prices. HP DesignJet 230 E-size model priced at \$3,195. HP DesignJet 250C E-size model priced at \$3,995. Price does not include optional bags. Plot designed by Mirella Griffo, Inc. In Canada, call 1-800-387-3667. Ext. 9553. ©1995 Hewlett-Packard Company PE13554



**HEWLETT®  
PACKARD**



# DIGICOM TAKES



**pentium®**  
PROCESSOR

# ONE STEP

# FURTHER

*Digicom is one of the oldest international computer manufacturers in the PC industry, offering a variety of high quality, low cost systems. Digicom's success is built on our ability to be Always One Step Ahead Of The Competition. We are the leader in PCI, Pentium® Processor-based systems.*

*Call us.....*

## **Penpro-SP-75/90/100**

Intel Pentium® Processor-75/90/100MHz  
SIS 501/502/503 Chipset  
256K/512K Cache  
4 PCI + 4 ISA slots  
Award BIOS  
Green Function

## **Penpro-PCIP-90/100**

Intel Pentium® Processor-90/100MHz  
Intel Neptune Chipset  
256K Cache  
3 PCI + 5 ISA slots  
2 Serial/1 Parallel/1 FDD/2 IDE Interface

## **Penpro-PCIA-75/90/100**

Intel Pentium® Processor-75/90/100MHz  
Intel Triton Chipset  
256K Cache  
Support EDO DRAM  
3 PCI + 4 ISA slots  
2 Serial/1 Parallel/1 FDD/2 IDE Interface  
Sound on board

## **Penpro-PCIZ-75/90**

Intel Pentium® Processor-75/90MHz  
Intel Triton Chipset  
256K Cache  
Support EDO DRAM  
3 PCI + 4 ISA slots  
2 Serial/1 Parallel/1 FDD/2 IDE Interface

## **Penpro-PCIH-60/66**

Intel Pentium® Processor-90/100MHz  
Intel Mercury Chipset  
256K Cache  
3 PCI + 4 ISA slots  
2 Serial/1 Parallel/1 FDD/2 IDE Interface  
PCI Local Bus VGA-1MB





EUROPE:  
**DIGICOM  
 EUROPE B.V.**  
 WAGENMAKERSTRAAT 7  
 2984 BD RIDDERKERK  
 THE NETHERLANDS  
 FAX: 31-1804-19815  
 TEL: 31-1804-11888

ASIA:  
**ANPRO INC.  
 DIGICOM GROUP**  
 9FL, NO. 2, LANE 235,  
 PAO-CHIAO ROAD,  
 HSIN-TIEN CITY, TAIPEI COUNTY,  
 TAIWAN, R.O.C.  
 FAX: 886-2-917-9099  
 TEL: 886-2-917-8555

U.S.A.  
**AMERICAN  
 DIGICOM CORP.**  
 CALIFORNIA OFFICE:  
 1233 MIDAS WAY  
 SUNNYVALE,  
 CA 94086 U.S.A.  
 FAX: 408-245-1584  
 TEL: 408-245-1580

NEW YORK OFFICE:  
 125 MICHAEL DRIVE  
 SUITE 103 SYOSSET,  
 NY 11791 U.S.A.  
 FAX: 516-496-2366  
 TEL: 516-496-2323

TEXAS OFFICE:  
 610 PRESIDENTIAL  
 DR. SUITE 104  
 RICHARDSON  
 TX 75081 U.S.A.  
 FAX: 214-480-0199  
 TEL: 214-480-9998



2

MOST  
IMPORTANT

BYTE

20TH ANNIVERSARY  
REPORTSoftware  
Prod

The 20-year story of personal computing often seems to be dominated by hardware. But it's the software that makes the hardware worth owning: Many early buyers of Apple IIs walked into stores and asked for the VisiCalc machine.

### ■ CP/M 2.0

Developed by the late Gary Kildall in 1974, CP/M was the first OS to run on machines from different vendors. It became the preferred OS for most software development, and it looked like it would rule forever.

### ■ VisiCalc

Written in 1979 by first-year Harvard Business School student Dan Bricklin and Bob Frankston of MIT, VisiCalc was a god-send to Wall Street users who had bought the first microcomputers two years earlier. Running initially on the Apple II and nearly single-handedly creating the demand for the machine, VisiCalc established spreadsheets as a staple application, setting the stage for Lotus 1-2-3 on the IBM PC in 1982.

### ■ WordStar

While writing programs on the Altair, Michael Shryer hit upon the idea of writing the manuals on the same machine. Electric Pencil was born, the first microcomputer word processor. But the first program to exploit the market potential was Seymour Rubinstein's 1979 masterpiece, WordStar.

Other programs took up WordStar-compatible keyboard commands—including the last major upgrade of Electric Pencil.

### ■ dBase II

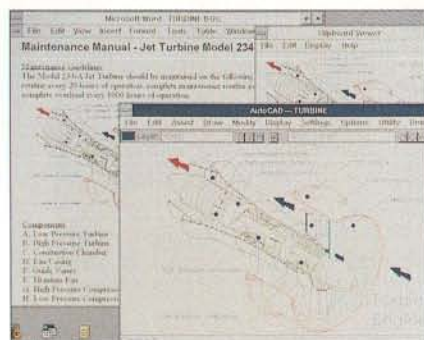
Wayne Ratliff's creation, first intended to manage a company football pool, was the first serious database management system for CP/M. dBase II, in its DOS incarnation, was a massive success. Ashton-Tate, which acquired dBase from Ratliff, began to lose the lead when it released the bug-ridden dBase IV in 1988. A Windows version (under the ownership of Borland) didn't appear until 1994, much too late. The dBase language survives in the form of Xbase, supported by vendors such as Microsoft and Computer Associates.

### ■ AutoCAD

Autodesk's AutoCAD started life as a CP/M (Control Program for Microcomputers) application, later moved to DOS, and eventually made the transition to Windows. It brought CAD from minis and mainframes down to the desktop, one of the first programs to make that now-common migration. AutoCAD quickly became—and remains—an industry standard.

### ■ Lotus 1-2-3

VisiCalc may have sold Wall Street on the idea of electronic spreadsheets, but 1-2-3 was the spreadsheet that Main Street wanted, too. When the IBM PC and XT took over the world, Lotus's simple but elegant grid was without question the top spreadsheet to run on them, adding graphics and data-retrieval functions to the paradigm established by VisiCalc. By the early 1990s, Lotus could brag that 1-2-3 was the top-selling application of all time.



IT SLICES, IT DICES, IT RENDERS, IT MODELS. AUTOCAD SINGLE-HANDEDLY WRESTED DESIGN FROM MINICOMPUTERS.

DIS 7/16 (0) .33  
(C) 1980 Software Arts, Inc.  
D1391896

A	B	C
1Telephone	75	75
2Life Ins	115	115
3Food	350	350
4Clothing	120	120
5Savings	177	177
6		
7Leisure	223	223
8Sav Acct	0	
9Car Insur	160	
10Interest	.42	.49
11	100	117.08
12		294.24
13Mortgage	.33	.33
14Utilities	.08	.08
15Telephone	.04	.04
16Life Ins	.06	.06

QUITE POSSIBLY THE PROGRAM RESPONSIBLE FOR THE '80'S WALL STREET FRENZY: VISICALC ON THE APPLE II.



APPLE'S MACINTOSH OS HAD THE FIRST REAL GRAPHICAL USER INTERFACE AND AWESOME EASE OF USE. TOO BAD WINDOWS DIDN'T COPY MORE OF IT.



# ucts

## ■ The Norton Utilities

Before Peter Norton rolled up his sleeves, bit twiddlers were on their own when it came to recovering lost clusters and managing other disk catastrophes. It's almost the end of the millennium, and most of us still reach for Norton Utilities when something goes wrong with a disk.

## ■ DOS 2.0

The version of DOS that truly solidified the Microsoft/IBM platform dominance was 2.0, which came out with IBM's new XT in 1983. DOS 2.0 had commands to support the XT's new 10-MB hard drive as well as such now-familiar external commands and files as ANSI.SYS and CONFIG.SYS.

DOS 2.11 became the de facto basis of backward compatibility for any DOS program. In 1990, you might not have known if an application ran on DOS 5.0, but you could be sure it worked on old 2.11. DOS limitations even survive in Windows 95—in particular, the dreaded 640-KB memory limit.

## ■ Flight Simulator

To work its magic, Microsoft's simulation of an airplane's cockpit employed low-level graphics routines. It became a mainstay of software suites used to test compatibility with the IBM PC standard. It was also one of the best-selling games of all time.

## ■ Novell NetWare

The year of the LAN happened sometime in the 1980s, and it was Novell's NetWare that made it so. NetWare is no lightweight desktop OS. NetWare was an OS that systems administrators could rely on. Versions of this OS are still in use in businesses everywhere.

## ■ Unix System V

The best effort so far at unifying the diverse flavors of Unix, System V took off after AT&T's divestiture in 1984, when Ma Bell was freed to market the OS more aggressively. Version 4.0, released in 1989, brought together Xenix, SunOS, 4.3 BSD, and System V to form a single standard. Hardware vendors continued to go their own ways, however, requiring subsequent efforts by numerous groups (e.g., X/Open, OSF, and COSE) to continue the fight for a shrink-wrappable Unix. Those efforts have mostly failed, but Unix's communications standards and network protocols are finding a wider user base as the Internet explodes in popularity.

## ■ Mac OS and System 7

The Macintosh wouldn't be the Macintosh without the Mac OS. And it was on the Macintosh that the concept of the desktop GUI really dug in. Later named System 7 in a major 1990 upgrade, the Mac continues to best Windows in ease of use, plug-and-play compatibility, and color matching. Apple's Power Macs and the first Mac clones just might keep System 7 relevant into the next century.

## ■ Quicken

This checkbook-balancing program may be better-suited to the needs of its users than any other program on this list save VisiCalc. Scott Cook's company grew from humble beginnings in the mid-1980s to become Microsoft's multibillion dollar dance partner (until the Department of Justice cut in). Once you start balancing your checkbook in Quicken, you don't ever go back.

17  
YEARS  
AGO IN  
**BYTE**



Editor in chief Carl Helmers editorialized about "...Using a Personal Computer for a Practical Purpose."

President Carter signs bill intended to reduce unemployment and inflation to 4 percent and 3 percent, respectively.

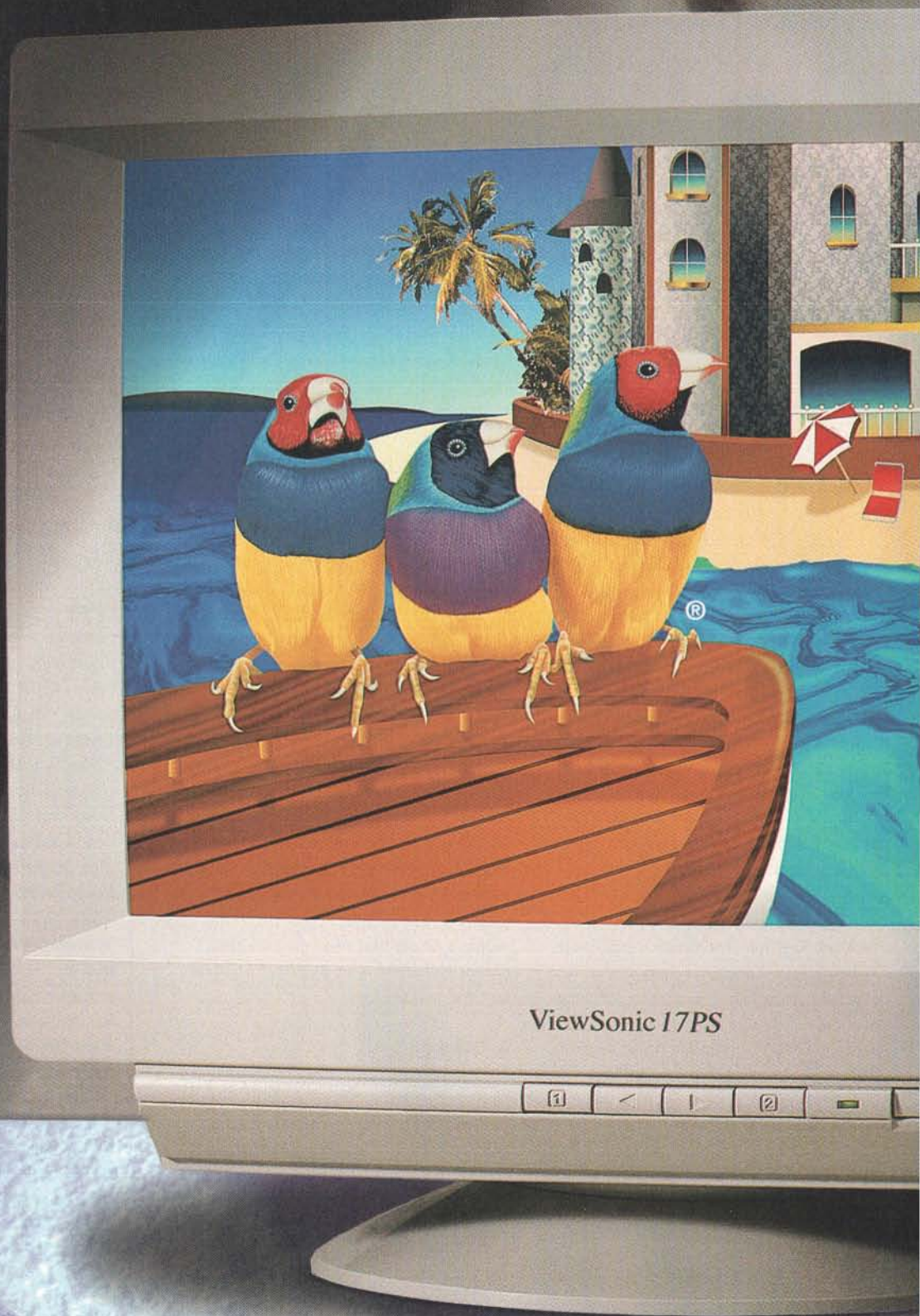
## CP/M Lives

CP/M provides the personal computer industry with its most enduring piece of folklore. When IBM began hunting around for an OS for its planned PC, it sent representatives to Gary Kildall's California office. Kildall was out flying his plane at the time and apparently thought communing with the big blue sky was more important than Big Blue. (Kildall later revealed that other talks with IBM had been inconclusive.) This was possibly the worst display of business acumen since New Hampshire's McDonald brothers sold most of their little hamburger-joint concept to a guy named Ray.

IBM quickly worked out a deal with a young fellow named Bill Gates. Ironically, 86-DOS, the OS that Microsoft bought and turned into MS-DOS 1.0, employed such CP/M commands as REN, Dir, and Type, which are still in use today.



# The Definition of





# Sharpness.

.25mm Ultra Fine



**Introducing the ViewSonic 17PS. The first 17" monitor with an *Ultra Fine* 0.25mm dot pitch. The ultimate in sharpness . . . precisely what you need!**

Our new Ultra Fine monitor truly defines sharpness. With its ultra crisp, ultra brilliant image this powerful monitor is the intelligent choice for your business and graphics applications. Ultra Fine images are nothing new from ViewSonic. The ViewSonic 21PS was the first 21" monitor (19.7" diagonal viewable area) available with a 0.25mm dot pitch, and now it's offered on our top performing 17" monitor (15.7" diagonal viewable area).

The ViewSonic 17PS retains all the superior features that make ViewSonic monitors award winning market leaders. Our OnView™ on-screen control system, Super Contrast screen and exclusive ARAG® anti-reflection, anti-glare screen coating combine to produce the sharpest images possible. PC and Mac compatible, our new 17" monitor supports a maximum resolution of 1,600 x 1,280 and a 77Hz refresh rate at 1,280 x 1,024. The remarkably quick refresh rates and high resolutions offer you crystal clear, flicker-free images. In addition, the ViewSonic 17PS includes *Plug & Play*™\* for automatic graphic card configuration with Microsoft's Windows95™, plus TCO certification, the strictest Swedish safety standard.

Designed for your critical desktop publishing, business graphics and CAD/CAM applications, the ViewSonic 17PS is an example of our ongoing commitment to offer you the best monitor at the best price.

**Experience the new world class standard in 17" monitors – the ViewSonic 17PS. You'll See the Difference!**

**ViewSonic®**  
**See The Difference!™**

Tel: (800) 888-8583 Ext. 353 or (909) 869-7976  
Fax (909) 869-7958  
Call FaxSonic (909) 869-7318 (24-hour fax-on-demand)  
Request Doc. 153 (17PS), 162 (21PS)  
Applelink: VIEWSONIC Compuserve: 73374,514

\*Requires a DDC compatible card.

All products and trademarks are brand names of their respective companies. The three bird logo is a registered trademark of ViewSonic Corporation. Specifications and prices subject to change without notice.



Circle 252 on Inquiry Card (RESELLERS: 253).



# Software Products

## Tomorrow's Top Five Software Categories

Which programs will be the VisiCalcs and WordStars of the next five years? We've seen the future...

### 1) COLLABORATION SOFTWARE

Lotus Notes is proving the value of shared text bases, and E-mail-based alternatives like Collabra Share and Open Mind are also bringing the benefits of group conferencing to new users. As smart agents, natural-language processing, and perhaps expert systems are brought to bear on electronic collaboration, PC-based interaction may begin to rival TV in its impact on society.

### 2) TEXT SEARCH AND RETRIEVAL

Finding the kernels of information embedded in the chaos of data is a problem that's only going to get bigger, as knowledge bases on CD-ROM and networks continue to grow. The basic pattern matching and Boolean slicing now in place will continue to do most of the work. But look for AI techniques and software agents to find needles in electronic haystacks as well as to present and store the results in a more personalized—and personable—form.

### 3) OBJECT OPERATING SYSTEMS

So far, the revolution in OOP (object-oriented programming) has been mostly fought in languages and developer tools. The next step is to build an entire OS from objects. There already is such a system, NextStep. Steve Jobs' critically acclaimed box-office flop. Taligent plans to release its entrant sometime in 1996. Even NextStep, long lauded for its elegance but used by only a small

fraction of developers, might impact the Windows/PC world when a Windows version comes out next year. Object-based operating environments will facilitate other important technologies, such as modular applications, agents, and distributed computing.

### 4) MULTIMEDIA DATABASES

No, we're not talking about the desktop file managers that help you pull together 5-second videos for a presentation. This new category is about the huge databases from Oracle, Sybase, and others that will power the coming convergence of computers and the entertainment business. Multimedia databases will be needed to manage the huge libraries of films delivered to homes via cable, as well as to process viewer input as consumers order from on-line catalogs or vote on the endings of soap operas.

### 5) AGENTS AND AVATARS

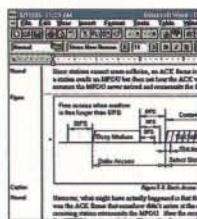
The promise of software agents is that they will begin to handle people problems, not just under-the-hood technical chores. General Magic's Magic Cap PDA (personal digital assistant) language is a good example, while the E-mail sorters and sifters that were first introduced years ago are becoming de rigueur in E-mail and other collaboration software. When all the world becomes a database, we'll need agents to keep from drowning.



IF THIS IS THE FUTURE OF GAMES, WE'RE DOOMED.



EXCEL, BUILT ON MISTAKES OF OTHERS (SEE BELOW).



WORD 6.0: ACCORDING TO SOME, THE BEST APPLICATION EVER WRITTEN.



LOTUS HAD IT BUT LOST IT. A GOOD WINDOWS SPREADSHEET, BUT TOO LATE.

### SideKick 1.0

Besides being the first PIM (personal information manager), its pop-up notepad, calendar, and calculator made Borland International's SideKick the model for TSRs—an application type that was relatively rare in 1984. Pop-up mini-apps became commonplace in the DOS era, but Windows' task switching killed the TSR market in the 1990s.

### Excel for the Macintosh

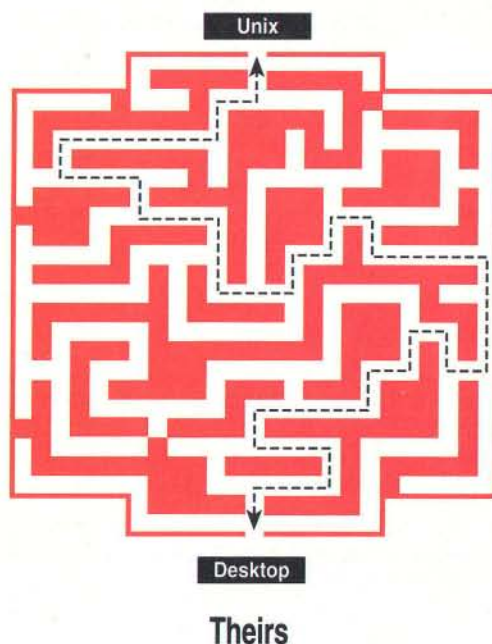
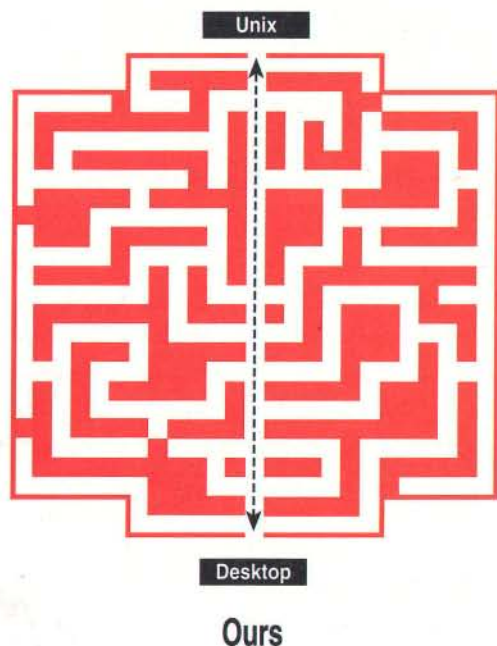
VisiCalc and Lotus 1-2-3 started the spreadsheet revolution, but they were character-based. Microsoft Excel for the Macintosh made the benefits of graphical spreadsheets obvious. Microsoft ported Excel to Windows, but Lotus was slow to convert 1-2-3 to Windows. There's a lesson here: Today, Excel for Windows is the best-selling spreadsheet.

### PageMaker

This is the program that launched a million newsletters. PageMaker's paste-up metaphor also made sense to people who had worked in traditional design and production departments. QuarkXPress might now have a larger share in higher-end publishing, but with Adobe's money and name behind Aldus, PageMaker promises to remain a com-



# Enterprise Networking? Enterprise Nightmare?



**If you're lost in the Maze, Locus Computing can help you through.**

PC-Interface from Locus Computing provides complete desktop access to the entire Unix file system including enterprise wide NFS, AFS or DFS/DCE without changing the DOS, Windows or Macintosh interface. Best of all, there are no mount tables - saving you time and money by eliminating costly Unix or desktop administration. Robust TCP/IP protocols, Internet and enterprise email interface, Internet file transfer, and Unix terminal emulation features provide a comprehensive, enterprise wide networking solution.



## PC-Interface

From Locus Computing  
Step up to World-Class  
Network Integration

PC-Interface employs standard Unix methods for user authentication, file access security, and file/record locking across DOS, Windows, Macintosh or Unix platforms.

PC-Interface also supports Kerberos authentication for secure access to enterprise wide file systems by desktop users.

PC-Interface will be available with full support for Windows 95, offering seamless integration into the Win95 'Network Neighborhood'.



**Find your way out of the maze , with Locus' PC-Interface cross platform integration evaluation kit - on the system of your choice. Limited supply, so call Locus now on -**

**+44 (0) 1442 871774**

Contact Locus on the Internet: World Wide Web: <http://www.locus.com> Internet email: [eurosales@uk.locus.com](mailto:eurosales@uk.locus.com) [ussales@locus.com](mailto:ussales@locus.com)

Or phone or fax the following Locus sales offices:

Europe, Middle East and Africa: +44 (0) 1442 871774, +44 (0) 1442 871118 FAX

North America: 1-800-95LOCUS (US only), (310) 670 6500, (310) 670 2980 FAX

Latin America, Asia/Pacific: +1 310 337 5017, +1 310 670 2980 FAX

Circle 549 on Inquiry Card (RESELLERS: 550).



# Software Products

petitive desktop publishing system for a long time to come.

## ■ LANtastic

For people who thought Novell NetWare was for corporate MIS gurus, Artisoft's affordable network-card-and-software package was an easy and popular way to link PCs and share resources. With the addition of NetWare server functions in Artisoft's new LANtastic Dedicated Server, LANtastic keeps a foothold in the future.

## ■ Adobe Type

Desktop publishing was still a bit of a toy when Adobe made Type 1 PostScript fonts available on the Macintosh. Thanks to these fonts and the enhanced line spacing and printing control that PostScript provides, the Mac became a tool on which to run a publishing business.

## ■ Windows 3.x

Though it was first introduced in 1985, Microsoft Windows spent the rest of the '80s as somewhat of a joke. It was slow, ugly, and underpowered. Then Microsoft rolled out Windows 3.0, a complete rewrite, at a tightly orchestrated, bicoastal multimedia hypefest in the spring of 1990. Gone was the 640-KB DOS memory limit (sort of); in came a flood of applications, a type of multitasking, and the desktop environment most users live in today. Version 3.1, released in 1992, added speed and stability, not to mention OLE, True Type fonts, and drag-and-drop commands.

## ■ Lotus Notes 3.0

Notes is the most innovative and powerful of the numerous contenders in the leading-edge groupware category. Not just E-mail, Notes is brilliant at capturing corporate group-think, thanks to its unique, replicated message system. Notes has become the standard applications development environment in every company that's ever uttered the word *reengineering*.

## The 10 Most Important Programs of Today

The best expressions of software evolution are available in shrink-wrap at your local Egghead.

### 1) EXCEL 5.0 FOR WINDOWS

In 1990, Excel was more of a Mac than a Windows spreadsheet. But then Lotus delayed bringing 1-2-3 to Windows. By 1993, most users had switched to Windows, and Excel had come to be regarded as the best Windows spreadsheet.

### 2) MAC SYSTEM 7

Still the best GUI with a wide following, System 7.5 is partially RISC-based—and thus in position to exploit the Power Mac—while still able to run old binaries.

### 3) MICROSOFT ACCESS 2.0

Though buggy and press-battered in its debut version, Access quickly established itself with a major upgrade as one of the easiest-to-use Windows databases. While Borland has struggled to keep Paradox and once-mighty dBase relevant, Access has easily outsold both.

### 4) NOVELL NETWARE 4.1

Looking like it might go the way of dBase and 1-2-3 thanks to a disappointing upgrade (4.0), NetWare is back on track with 4.1. Still, the masses are restless, and pretenders like Windows NT are maneuvering into position.

### 5) LOTUS NOTES

Notes has become an industry. No, it's a way of life. Still way out ahead technically, Notes has maybe a year or two to solidify its position against an onslaught of workgroup programs like Collabra Share.

### 6) WINDOWS NT

Clearly, this is the future of Windows. If Windows 95 falters at the start,

Microsoft has a completely redesigned, true 32-bit OS waiting in the wings. NT will even have the new Windows 95 look and feel.

### 7) WINDOWS 3.11

As we write this, Windows 95 still isn't out, so Windows 3.11 is the version that sits on most of the 50-million-plus Windows desktops. People love it; people hate it. But they use it.

### 8) WORD 6.0 FOR WINDOWS

It's big, slow, and overloaded with features. Still, Word 6.0 somehow manages to be the right tool for the simplest to the most complex text jobs. Some people regard it as the best application written.

### 9) WORDPERFECT

WordPerfect still sells lots of copies of the DOS version, and as the cornerstone for PerfectOffice, the suite from Novell, WordPerfect has a new lease on life. It continues to be the daily work environment of millions.

### 10) DOOM

Its motion-sickness-inducing virtual reality and large, cult-like following make this gory game from id Software the inspirational example for programmers of action software.

### PLUS: MICROSOFT OFFICE

Not a real program but rather a collection of Microsoft's market-dominating applications, Microsoft Office has transcended the dreaded "suite" designation to become the framework for which today's developers are writing new apps.



## VISUAL BASIC FOR WINDOWS

Visual Basic 3.0 for Win Std	£96
Visual Basic 3.0 for Win Prof	£230
Comms Lib/Win	£115
Distinct TCP/IP - Visual Edition	£265
DeSocket 1.1 (Intro)	£65
NetWare Client SDK for VB	£169
Network Library/Win 1.1	£80
PDQ Comm for Windows 2.1	£99
ADE/VBX	£350
CodeBasic 5.1	£140
Controls for Btrieve	£185
Crystal Reports Pro 4.0	£290
Data Widgets	£99
DataDirect Multilink/VB	£270
Grid/VBX	£75
Integra VDB/VB, Desktop	£209
List & Labels for VB	£279
TrueGrid Pro 2.1	£90
VB/ISAM MU	£150
VB/Link for Lotus Notes	£715
VBtrv for Windows	£185
Visual/db Network 3.0	£235
Accusoft Image Lib/VBX 5.0	£382
Image SDK Plus/VBX 2.0	£250
ImageKnife/VBX 2.0	£200
ImageMan/VB 3.0c	£239
ImageStream/VBX	£120
JPEG Image Compressor VBX	£169
LEADTOOLS VB 4.0	£425
PCX Toolkit for Windows	£155
3-D Widgets	£89
Chart FX 3.0	£225
Custom Control Factory	£49
Dazzle Prof 2.0	£420
Designer Widgets	£99
First Impression	£120
Formula One 2.0	£120
Gantt/VBX	£195
HighEdit 3.0	£199
MS Visual Control Pack	£69
Real-Time Graphics Tools - VB	£300
QuickPak Pro for Win 3.0	£145
Spread/VBX	£171
SpyWorks-VB	£120
TAB/PRO	£75
TLIST	£120
TX Text-Control Standard	£180
VB/Magic Controls	£120
VBAssist 3.5	£140
VBGraphix	£270
VBTools 4.0	£115
VB/Rig Professional	£79
VBX Artist	£240
WinWidgets/VBX	£160
3D Graphics Tools 4.0	£130
CodePrint Pro for VB	£85
Compression Plus 4.0	£175
d-Barcode VBX/DLL	£94

DynaZIP VBX 2.0	£129
FXTools/VB Std 1.5	£149
MediaKnife/VBX	£244
Microhelp Muscle/Win	£125
QuickPak Scientific for Win	£105
TMS Tools	£99
VB Compress	£99
VB Language Manager	£130
VB/DLL 1.0	£165
VERSIONS/VB 1.1	£135
Visual Developer's Suite	£216
Visual CAD Dev Kit	£520
Visual Instrument Panel Controls	£150
VisualSpeller	£120
VisualWriter Pro	£145
VSView	£105

## C & C++ FOR DOS

Comms	
Async Prof for C/C++ 2.1	£170
Greenleaf CommLib 5.1	£235
MagnaComm/DOS	£215
SilverComm "C" Asynch 4.0	£195
Database	
c-tree Plus 6.4b	£565
D-ISAM	£495
DataBoss 3.5 (Special Offer)	£79
SoftFocus Btree/ISAM	£75
Graphics	
3D-Ware Prof	£249
Essential Graphics Toolkit	£320
Fastgraph 4.0 (Ted Gruber)	£195
GFX Graphics/Fonts & Menus	£330
GX Graphics 3.0	£155
GX Images	£399
MetaWINDOW-DOS 4.4	£170
GUI	
4Sight	£300
Menuet/C 2.1	£300
MEWEL/GUI Std 4.0	£390
object-Menu w/Source 2.7	£510
Zinc Engine & DOS Key 4.0	£505
Math & Scientific	
C/Math Toolchest & Grafix	£45
Huge Virtual Array & NAT 3.0	£215
Science, Eng & Graphics Tools	£115
Memory Managers	
MegaHeap	£115
MoreHeap 3.23	£135
VMData for DOS	£665
Printer	
BD/CX (DOS)	£300
BGI Printer Driver Toolkit	£105
GX Printer 1.5	£240
SLATE	£260

## VISUAL BASIC FOR DOS

MS Visual Basic for DOS Std	£96
MS Visual Basic for DOS Prof	£230
NetPak Pro for DOS	£135
PDQ Comm	£65
QuickComm	£129
QuickNet	£79
RS232 Library	£130
db/Lib Prof 3.0	£195
VB/ISAM MU	£150
Graphics QuickScreen	£105
Graphics Workshop	£105
GraphPak Pro	£99
Compression Plus	£79
Compression Workshop	£110
PDQ	£110
Printer Plus	£130
ProBas 7.1	£210
QuickPak Prof 4.19	£145
QuickPak Scientific 3.0	£105
QuickScreen 4.0	£105

## C++ COMPILERS

Borland C++ 4.5	£280
Borland C++ 4.5 & DB Tools	£405
Microsoft Visual C++ Intel Ed	£299
Salford C/C++ Win Developer	£395
Symantec C++ 7.0	£199
Turbo C++ for Win 4.5	£68
Watcom C/C++ 10.0	£155
Microsoft Visual C++ Std	£65
High C/C++ for Ext-DOS/Win	£620
Salford C/C++ DOS Developer	£195
TopSpeed C/C++ Prof	£215
Turbo C++ 3.0	£66

# GREY MATTER

Prig Meakins, Ashburton, Devon TQ13 7DE

Prices do not include VAT or other local taxes but do include delivery in mainland UK. Please check prices at time of order as ads are prepared some weeks before publication. This page lists some of our products - call us for a complete price list. ORDER BY PHONE WITH YOUR CREDIT CARD

(01364) 654100

FAX: (01364) 654200

## News & Views

### IBM VisualAge C++

If you think that Visual Basic & Delphi represent the state of the art in visual development tools, then you haven't seen IBM's VisualAge. You design the GUI portions visually, as is usual these days, but you can also build the non-visual portions visually as well. They call it "visual construction from parts" and so far it has only been available in the expensive Smalltalk variant.

IBM have now combined this technology with the robust tools from C Set++ to produce the first of a new generation of C++ compilers, at a sensible price. The first version is for OS/2 (of course!), but a Win32 version is due in 6-9 months. Future platforms include Power Mac, Solaris, AIX and OS/2 Warp for Power PC.

The core of this cross-platform portability is Open Class, an enhanced version of the class library in C Set++. This provides over 400 classes covering user interface, database access, collections, data types and exceptions. Taligent will influence future enhancements.

A few other highlights include: Data Access Builder maps DB/2 tables to C++ classes, generating C++ & SQL code; Direct-to-SOM for generating CORBA-compliant objects; Project Smarts; new Browser (no need to compile); and advanced Debugger & Performance Analyser.

How much do you think IBM are asking for this technological powerhouse? After all, it is probably the most sophisticated C++ development system ever produced and won 2 out of 4 awards at Object World Boston '95? £1000 perhaps. At least £500? No. It can be yours for only £266 + VAT (CD-ROM + printed docs). Call us now before they change their mind!

### SpeedPascal/2

A 32-bit Borland Pascal for OS/2? Not quite, but this is as close as you'll get. The *Pascal Magazine* said: "If Borland were to produce a Borland Pascal for OS/2, I do not think that it could be very different from (or even much better than) Speed.".

Full GUI IDE with context-sensitive help, integrated debugger, resource editor, assembler, etc. And there is the only Application Framework for Pascal on PM called OPLM, which is similar to Borland's OWL.

With Borland favouring OWL behind in the Win16 world in leaving of VCL & Delphi, SpeedPascal/2 is the only way of porting your OWL apps to a 32-bit operating system. And SpeedSoft are working on a Windows version of the compiler as well. Call us now to order your copy (CD-ROM, online docs). Only £79 + VAT until the end of July, then £100 + VAT.

## PROGRAMMING TOOLS

Ada Basic	Assemblers
Comms	C/C++
Custom Controls	Cross Dev
Debuggers	Database
Editors	Dos Extenders
Graphics	Fortran
Linkers/Locaters	GUI
Modula-2	Lisp
Pascal	Multi-tasking
Smalltalk	Prolog
Version Control	SQL
Windows	Visual Programming
	Xbase

We stock many items for which there is no space in these advertisements.

## DELPHI

Delphi	£279
Delphi Client/Server	£806
Apiary Dev Suite for NetWare	£195
Conversion Assistant VB Std	£77
Eschalon Power Controls	£105
InfoPower (Intro)	£140
Mobius Business Builder (Intro)	£199
Mobius Draw Kit	£99
Mobius WinG Sprite Kit	£99
Orpheus	£135
VisualPro 1 - App Enhancement	£69
VisualPro 2 - Visual Video Pack	£99

## LOW PRICES

MICROSOFT & BORLAND PRODUCTS

Microsoft Access 2.0	£289
Microsoft Fortran 5.1	£138
Microsoft Fortran Power Station	£230
MS Macro Assembler 6.11	£110
MS Visual Basic for Win Std	£96
MS Visual Basic for Win Prof	£230
Microsoft Visual C++ 2.0	£299
Microsoft Windows 3.1	£78
Borland Database Engine	£205
Borland C++ 4.5	£280
Borland Pascal with Objects 7.0	£250
dBase 5.0 for DOS	£405
dBase 5.0 for Windows	£280
dBase Compiler 2.0	£245
Delphi	£279
Delphi Client/Server	£806
Turbo C++ 3.0	£66
Turbo C++ for Win 4.5	£68
Turbo Pascal 7.0	£94
Turbo Pascal for Windows 1.5	£99
Paradox for Win 5.0	£280

WITH FULL TECHNICAL SUPPORT

## BASIC LANGUAGE

CA-Realizer 2.0 (OS2&Win)	£179
GFA-BASIC for Windows	£80
GFA-BASIC for Win Compiler	£54
PowerBASIC Pro (Win&DOS)	£225
BBC BASIC-86 Plus	£75
GFA-BASIC for DOS	£80
PowerBASIC 3.1 (DOS)	£109
TrueBASIC Std 3.0	£88



# OFFICIAL STOCKISTS

## AUSTRIA

Please contact International Thomson Publishing GmbH - See Germany

## BELGIUM

Standaard Boekhandel  
Antwerpen  
Tel: 03.231.07.73  
Brussel  
Tel: 02.217.56.42  
Gent  
Tel: 09.225.53.77  
Hasselt  
Tel: 011.22.75.59  
Leuven  
Tel: 016.23.98.21

## CROATIA

*Zagreb*  
Algoritam  
Tel: 385 1 27-17-99

## DENMARK

*Aarhus*  
FTU Boghandel  
Tel: 86 10 03 38  
Gad Studiebogladen  
Tel: 86 13 10 66  
*Kobenhavn*  
Gad Norreport  
Tel: 33 12 91 48  
*Lynghy*  
Polyteknisk Boghandel  
Tel: 45 88 14 88

## EIRE

*Dublin*  
Waterstones  
Tel: 353 16 791 260

## FINLAND

*Helsinki*  
Akateeminen Kirjakauppa  
Tel: 90 12 141

## FRANCE

*Paris*  
Le Monde en Tique  
Tel: +33.1.43 25 45 20  
Infotheque  
Tel: +33.1.45 22 67 01  
Offilib  
Tel: +33.1.43.29.21.32  
Lavoisier  
Tel: +33.1.42.65.39.95

## GERMANY

International Thomson Publishing GmbH  
Königswinterer Straße 418  
53227 Bonn, Germany  
Tel: 49 (0) 228 970240  
Fax: 49 (0) 228 441342

## GREECE

*Athens*  
Papasotiriou  
Tel: +30.1.36 41 826

## ITALY

*Rome*  
Libreria Universitaria Ingegneria 2000  
Tel: +39.6.47 44 169  
*Milan*  
Hoepli Libreria  
Tel: +39.2.86487  
Libreria Dell' Informatica  
Tel: +39.2.86 90 375

## JAPAN

*Tokyo*  
Shosen Booktower  
Tel: 81-3 3295-0011

## MALTA

*Valletta*  
The Engineer's Centre  
Tel: +356.242806

## NETHERLANDS

*Eindhoven*  
Van Piere Boeken  
Tel: 040/44 40 45  
Email: Pierboek@euronet.nl  
*Utrecht*  
Broese Kemink  
Tel: 030/31 38 04  
Email: Broeseut@knoware.nl

## NORWAY

*Stabekk*  
Vett & Viten  
Tel: 67 12 50 90  
*Trondheim*  
Tapir  
Tel: 73 59 32 20

## PORTUGAL

*Lisbon*  
Escolar Editora Livraria  
Tel: +351.1.757 5055

## SPAIN

*Madrid*  
Díaz de Santos  
Tel: +34.1.431.2482  
*Barcelona*  
Tel: +34.3.212.8647

## SWEDEN

*Malmö*  
PC Boken  
Tel: 40 97 03 20  
*Stockholm*  
Akademibokhandelen  
Tel: 08 61 36 100

*Sundsvall*  
Computer Press  
Tel: 060 15 04 78

## SWITZERLAND

Please contact International Thomson Publishing GmbH - See Germany

## UK

*Bristol*  
Blackwell's  
Tel: 0117 9276602

*Cambridge*  
Dillons  
Tel: 01223 531 688

Heffers  
Tel: 01223 568568  
Email: orders@heffers.co.uk

*Edinburgh*  
James Thin  
Tel: 0131 556 6743

*Glasgow*  
John Smith and Son  
Tel: 0141 221 7472

*London*  
Dillons  
Tel: 0171-636 1577

Foyles  
Fax: 0171 434 1580

Modern Book Co  
Tel: 0171 402 9176

PC Bookshop  
Tel: 0171 831 0022  
Email: orders@pcbooks.demon.co.uk

Waterstones  
Tel: 0171 434 4291

*Oxford*  
Blackwell's  
Tel: 01865-792792

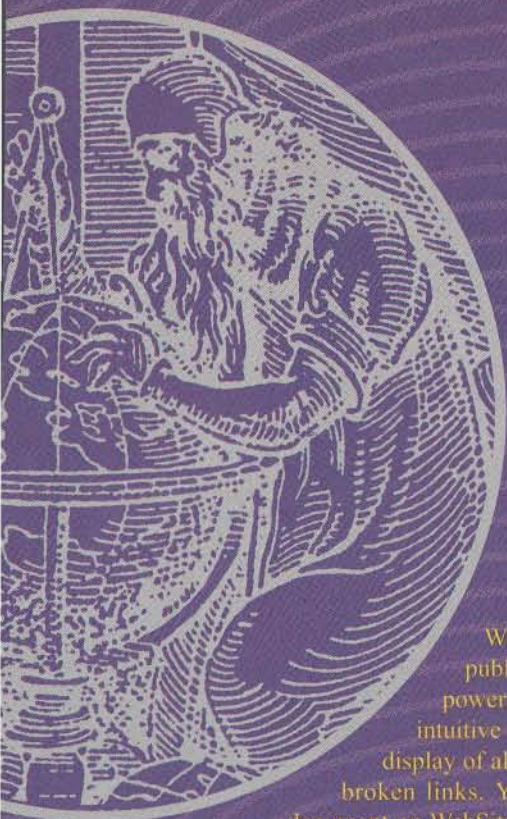
*Reading*  
Blackwell's  
Tel: 01734 595555

WebSite is not available from International Thomson Publishing in Australia and New Zealand.

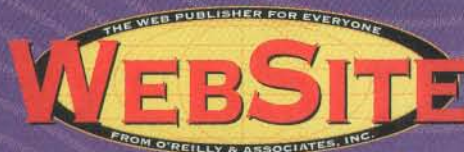
If your area does not have a bookshop listed, order directly from:

INTERNATIONAL THOMSON PUBLISHING SERVICES LTD, Cheriton House, North Way, Andover,  
Hampshire. SP10 5BE, UK. Tel: (0) 1264 332424 Telex: 47214 Giro Account No: 209 6919 Fax: (0) 1264 342 787  
Email Addresses: UK and Eire orders: ITPUK@ITPS.CO.UK International orders: ITPINT@ITPS.CO.UK





# NAVIGATE THE INTERNET



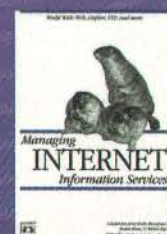
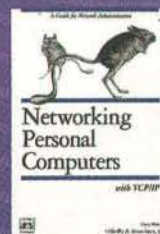
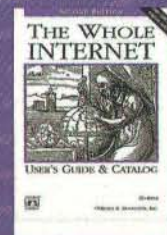
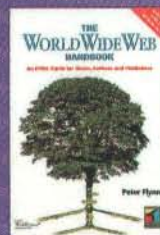
## FOR ANYONE WHO WANTS TO PUBLISH INFORMATION ON THE WEB

WebSite is an elegant, easy solution for Windows NT 3.5 users who want to start publishing on the Internet. WebSite is a 32-bit World Wide Web server that combines the power and flexibility of a Unix server with the ease of use of a Windows application. Its intuitive graphical interface is a natural for Windows NT users. WebSite provides a tree-like display of all the documents and links on your server, with a simple solution for finding and fixing broken links. You can run a desktop application like Excel or Visual Basic from within a Web document on WebSite. Its access authentication lets you control which users have access to different parts of your Web server. In addition to NT 3.5, WebSite runs on the current version of Windows 95. WebSite is a product of O'Reilly & Associates, Inc. **1-56592-143-7 £345.00 (+ local Taxes)**

## AMATEUR OR PROFESSIONAL WE HAVE THE BOOK FOR YOU!

Costales/Sendmail  
1-56592-056-2/£24.50  
Flynn/The WorldWideWeb  
Handbook  
1-85032-205-8/£24.95  
Ford/Spinning the Web  
1-85032-141-8/£19.95  
Garfinkel/PGP: Pretty Good Privacy  
1-56592-098-8/£18.50  
Harrison/The USENET Handbook  
1-56592-101-1/£18.50  
Hellman/The Multimedia Casebook  
0-442-01819-3/£37.00  
Hunt/Networking Personal  
Computers with TCP/IP  
1-56592-123-2/£22.50  
Joy/Beginning UNIX  
0-412-57660-0/£15.99  
Kirch/Linux Network  
Administrator's Guide  
1-56592-087-2/£18.50  
Koman/The Mosaic Handbook  
(X Window)  
1-56592-095-3/£22.00  
Koman/The Mosaic Handbook  
(Microsoft Windows)  
1-56592-094-5/£22.00

Koman/The Mosaic Handbook  
(Macintosh)  
1-56592-096-1/£22.00  
Krol/The Whole Internet 2e  
1-56592-063-5/£18.50  
Lamb/Using Email Effectively  
1-56592-103-8/£10.95  
Liu/Managing Internet  
Information Services  
1-56592-062-7/£21.95  
Liu/DNS and BIND  
1-56592-010-4/£22.00  
Loeffler/The Virtual Reality  
Casebook  
0-442-01776-6/£26.00  
Peek/MH & xmh 3e  
1-56592-093-7/£22.00  
Sluman/CompuServe for  
Europe  
1-85032-121-3/£19.95  
Sluman/Internet Made Easy  
1-85032-240-6/£16.95  
Sluman/Quick Tour Guide  
to WinCIM  
1-85032-153-1/£9.95  
Welsh/Running Linux  
1-56592-100-3/£18.50



O'Reilly & Associates, Inc.



All the chips on this list, obscure as some are, had a significant influence on the evolution of personal computing. So what does it take to make a computer today? Mostly, it seems, acronyms: a CPU, some RAM, a handful of EPROMs, a DSP, and a PCI bus.

#### ■ Intel 1103

In 1970, Intel created the 1103—the first generally available DRAM chip. By 1972, it was the best-selling semiconductor memory chip in the world. Today, you would need more than 65,000 of them to put 8 MB of memory into a PC.

#### ■ Intel 1702

In another brilliant stroke of naming, Intel created this, the first EPROM, in 1971. When you say “firmware,” smile and think of the 1702.

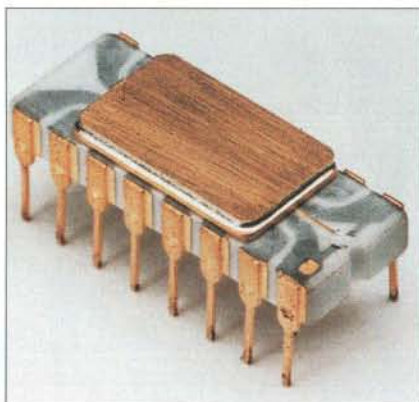
#### ■ Intel 4004

In 1971, Busicom, a Japanese company, wanted a chip for a new calculator. With incredible overkill, Intel built the world's first general-purpose microprocessor. Then it bought back the rights for \$60,000.

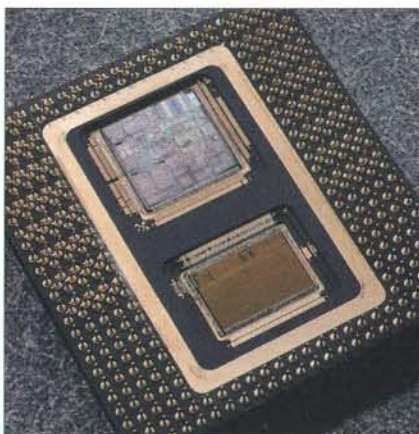
The 4-bit 4004 ran at 108 kHz and contained 2300 transistors. Its speed is estimated at 0.06 MIPS. By comparison, Intel's latest microprocessor, the P6, runs at 133 MHz, contains 5.5 million transistors, and executes 300 MIPS.

#### ■ Intel 8080

If you drive, your life probably depends on this chip. Introduced in April 1974, the 8080 was first widely used as a traffic-light controller. It found its way a year later into the world's first personal computer: the MITS Altair.



THE INTEL 4004. IT WAS SUPPOSED TO BE THE BRAINS OF A CALCULATOR. INSTEAD, IT TURNED INTO A GENERAL-PURPOSE MICROPROCESSOR AS POWERFUL AS ENIAC.



THIS IS INTEL'S P6: ALL 5.5 MILLION TRANSISTORS, 133 MHz, AND 300 MIPS OF IT. IT'S ROUGHLY 5000 TIMES AS FAST AS THE 4004. YOU'VE COME A LONG WAY, x86.

#### ■ MOS Technology 6502

What do a Nintendo set and a BMW have in common? The 6502. At \$25 (compared with \$375 for a comparable Motorola part), the 6502 was such a steal that a talented but cash-poor whiz kid from Silicon Valley, Steve Wozniak, chose it for his new personal computer, the Apple I.

#### ■ Zilog Z80

Remember Tandy's TRS-80 Model I? Remember CP/M? They were both built on the Z80.

#### ■ Intel 8086 and 8088

Enter the King. In June 1978, the 8086 debuted. Today it stands for the world's most popular microprocessor standard: the x86 architecture. A year later, Intel introduced a slight variation, the 8088, that could use 8-bit components, enabling the manufacture of inexpensive systems. For that reason, IBM chose the 8088 over the 8086 for the original IBM PC, even though the 8088 was slower.

#### ■ Intel 386DX

The 386 heralded the beginning of a new age—the age of multitasking. Introduced in October 1985, the 386 was the first “modern” x86 processor that was capable of running today's multitasking OSes, GUIs, and 32-bit software.

The 386 introduced an enhanced microarchitecture while maintaining full backward compatibility with earlier x86 processors. This was accomplished with two memory-addressing modes: real mode, which mirrored the way memory is addressed by the older x86s, and a new protected mode that took full advantage of the 386's 32-bit enhancements.



# Chips

16  
YEARS  
AGO IN  
**BYTE**

We published a simple program (220 bytes) to play Life on an 8080 system.

Returned exile and scholar Ayatollah Khomeini declares Iran an Islamic republic.



THE CHIP THAT LAUNCHED  
68000 MACINTOSHES.



IT DIDN'T DIVIDE, BUT IT  
CONQUERED ANYWAY.

## ■ Intel Pentium

The Pentium swept through the PC industry faster than any of Intel's previous chips. Although Intel's 486DX (April 1989) integrated an FPU and was much faster than the 386, it was the Pentium that introduced the next leap forward in the x86 microarchitecture: superscalar pipelines. Skeptics said a CISC architecture couldn't do it. The Pentium proved otherwise.

## ■ AMD 386DX

Let the price wars begin. When Intel's original 16-MHz 386 was introduced in 1985, it cost \$299; more than five years later, it was still commanding the relatively high price of \$171, and the 33-MHz version fetched \$214. AMD's 386DX/40 appeared in March 1991 at \$281, but within a year its price plunged 50 percent to \$140. Street prices of PCs, which follow chip prices, fell by as much as \$1000. The market for Windows-capable PCs expanded by 33 percent.

## ■ Motorola 68000

More than any other, this is the micro-processor that helped establish the GUI. In 1983, four years after its introduction, it appeared in Apple's Lisa, a unique computer but a commercial flop that nevertheless paved the way for the Macintosh in 1984.

## ■ Mips R2000

The R2000, introduced in 1986, was a 32-bit CPU with 110,000 transistors. It powered the first generation of RISC workstations and servers. The original version, clocked at 8 MHz, executed about 5 MIPS and had a separate FPU.

## ■ Sun Microsystems SPARC

In July 1987, Sun announced an open RISC architecture. The idea was to encourage multiple sourcing and lively competition that would spur performance and spread the SPARC standard far and wide. Eight years later, SPARC workstations and servers dominate their markets.

## ■ IBM/Motorola PowerPC 601

Although few doubted the power of the PowerPC architecture, many thought the politics of the IBM/Motorola/Apple relationship was going to be unmanageable. In less than two years, it has spawned the world's most popular RISC platform: the Power Macintosh.

## ■ Chips & Technologies AT Chip Set

IBM is not known for its approach to open systems. So, while it was actively resisting the cloning of its PC architecture, C&T was introducing its AT Chip Set. With only five chips, C&T duplicated the core logic of about 100 chips in IBM's system. All a clone maker had to do was add a 286, a Phoenix BIOS ROM, and some memory to create a PC. Take that, Big Blue.

## ■ Amiga Agnes/Denise/Paula

It's not a rock group: This was the advanced chip set that powered the world's first multimedia computer: the Commodore Amiga 1000. In 1985, these three chips could do tricks that today's PCs and Macs still can't do—such as display multiple screens with independent pixel resolutions and bit depths on a single monitor.

## ■ Commodore SID

You can get remarkable results when you tell an engineer to do what he thinks is right. Take SID (Sound Interface Device), for example. In 1981, Bob Yannes was told to design a low-cost sound chip for the upcoming Commodore 64. He would end up creating an analog synthesizer chip that redefined the concept of sound in personal computers.

## ■ Yamaha OPL-2

Tweet. Beep, beep. Name that tune! The original IBM PC's sound capabilities were practically nonexistent—a simple beeper that could produce a limited range of square-wave tones. Yamaha's OPL-2 enabled vendors such as Ad Lib and Creative Labs to introduce plug-in sound boards with reasonable (but not great) sound. Today, nearly all PCs come with a sound board.

## ■ S3 911

Because PCs originally had character-oriented displays, screen performance drastically bogged down when running Microsoft Windows and graphical applications. IBM's 8514 chip and its spin-offs provided some improvement, but the market broke wide open in 1991 when S3 introduced the 911, which integrated GUI acceleration and VGA compatibility on a single chip.

## ■ Intel Mercury

The PCI (Peripheral Component Interconnect) bus is the most important enhancement to the PC architecture since the ISA bus, and Mercury was the first implementation. Today even Apple has adopted PCI to replace the NuBus.



# GET PENTIUM.



#### Pentium™ Power:

The super-quick Pentium™ processor is designed specifically for notebooks and is engineered to perform 91% faster than 75MHz Intel DX4™ processors.

# GET CD-ROM.

#### CD-ROM to Go:

The power of multimedia is all packed up and ready to go. The Satellite Pro™ 400CDT comes with an integrated, modular Quad-Speed CD-ROM drive that you can swap with the floppy drive in seconds\*. Or plug in the floppy drive externally and use both.

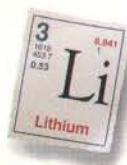


## THE NEW SATELLITE PRO™ WITH MODULAR CD-ROM.

**Satellite Pro™** The new Satellite Pro™ offers faster access to your multimedia applications with a Quad-Speed CD-ROM.

Now you can retrieve masses of information from large databases and enjoy the hottest educational and entertainment software.

A huge 10.4" diagonal color display and 24-bit true color support deliver brilliant graphics and stunningly realistic images that will leave you in awe. Crisp, clear stereo sound capabilities and smooth video playback will wake up any presentation. The Satellite Pro™ is portable multimedia computing at its highest level. So get going. Call 1-800-457-7777 for more information or a dealer near you.



#### Lithium Ion Battery:

Toshiba's long-life Lithium Ion battery provides many hours of power while you travel.



#### Enhanced Port Replicator:

Now you only need one computer. The new, optional Enhanced Port Replicator provides two Type III PC Card slots, and allows one-step connection to your desktop environment.



#### Built-in Power Supply:

A built-in power supply means you don't have to carry a bulky external AC adapter. This slim power cord is all you need.



# GET GOING.



#### 400CDT:

- 10.4" dia. color active matrix display
- Integrated modular Quad-Speed CD-ROM
- Modular 3.5" FDD included

#### 400CS\*:

- 10.4" dia. color dual-scan display
- Integrated modular 3.5" FDD
- Optional modular Quad-Speed CD-ROM

#### BOTH MODELS:

- 75MHz Pentium™ processor (2.9v)
- Supports 24-bit true color (16.7 million colors)
- 810 Million Bytes (=772MB) HDD
- 8MB EDO RAM expandable to 40MB
- Lithium Ion battery
- VL local-bus video

- Sound Blaster™ Pro compatible, .WAV and MIDI sound support
- Two stacked PC Card slots (two Type II or one Type III)
- Plug and Play connectivity
- AccuPoint™ integrated pointing device
- Toshiba MaxTime™ Power Management Software

- Toll-free Technical Support — 7 days a week, 24 hours a day



In Touch with Tomorrow  
**TOSHIBA**

**Toshiba. The World's Best Selling Portable Computers.**

All specifications and availability are subject to change. †400CS comes with the modular FDD only. A Quad-Speed CD-ROM is available as an optional upgrade. \*The 400CS is sold at selected retailers as the 405CS with additional pre-installed software. © 1995 Toshiba America Information Systems, Inc. All products indicated by trademark symbols are trademarked and/or registered by their respective companies. The Intel Inside logo is a trademark of Intel Corporation.

Circle 249 on Inquiry Card.



The Amazonian piranha uses razor-sharp teeth to rip out bloody chunks of your quivering flesh until you thrash and convulse in mind-numbing agony and plead for someone to kill you.

[Sort of like using someone else's network fax solution.]



Everyone knows that network faxing is an amazingly convenient way for people to fax right from their PCs. So there's no more schlepping to the fax machine. Everyone also knows it's agonizingly painful to implement. But now there's Delrina WinFax™ PRO for Networks 4.1. Which does for network faxing what Delrina WinFax PRO™ did for personal faxing. Which is to finally make it easy. Installing it takes no time. It's simple to add users and modems. Sending a fax from any Windows application is as easy as printing a document. And since people share phone lines and modems, you save money. See your dealer or call us at 1-800-598-8679 for more information about WinFax PRO for Networks. And go ahead and jump right in to network faxing. The water's fine.



*WinFax PRO for Networks is based on WinFax PRO, the world's #1 fax software.*

**Delrina WinFax PRO for Networks works with your existing hardware and software, including all popular e-mail packages. • It works with all popular networks, including Novell NetWare, Personal NetWare, LANTastic, Banyan Vines, Microsoft® LAN Manager and Microsoft® Windows™ for Workgroups. • No dedicated fax server is required. • It's compatible with more than 600 modems. • It costs less than you think. • And it makes the ideal choice for workgroups of up to 50 people.**

**DELTRINA**

Delrina, WinFax PRO and WinFax PRO for Networks are trademarks of Delrina Corporation and its affiliated companies. Microsoft is a registered trademark of Microsoft Corporation. All other product names are copyrights, trademarks, registered trademarks or tradenames of their respective owners. ©1994 Delrina (Canada) Corporation. All rights reserved.

**Circle 340 on Inquiry Card.**



# Most Important Networking Products & Standards

Twenty years ago, networks were three-letter corporations that owned television. Today, they are the fabric of our information society. Following are the products that form the woof and warp of this new world.

## ■ SNA

IBM's mainframe networking standard, SNA (Systems Network Architecture), is arguably the major milestone in networking technology in the last 20 years. Virtually every Fortune 500 company's mainframe networks are based on it, as well as any other company that has an IBM mainframe. SNA, officially introduced in 1974 with products becoming available in subsequent years, gave users access to the enormous amounts of data stored on mainframes.

With SNA, IBM developed a layered approach to communications that was to be the basis for all the company's subsequent data communications work.

## ■ DECnet

Introduced in 1975, DECnet supported communication over a variety of networks, including Ethernet LANs and baseband and broadband networks. DEC adapted its architecture to interconnect workstations, terminals, PCs, Macs, PDPs, and VAXes.

Because of an architecture that put intelligence at each network node, and because of the connectivity to PDPs and VAXes, DECnet was widely embraced by research and academic communities.

## ■ TCP/IP

A funny thing happened while we were all waiting for OSI to take off. A stopgap networking solution developed years ago by the Department of Defense's

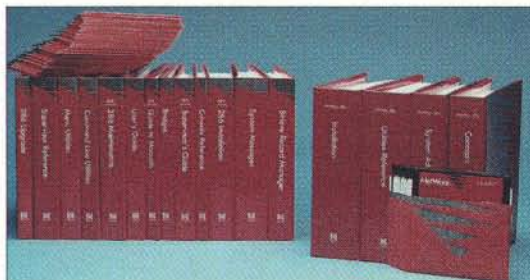
Advanced Research Projects Agency, TCP/IP, blew OSI off the map.

Between 1978 and 1980, the Defense Advanced Research Projects Agency developed and deployed the Transmission Control Protocol/Internet Protocol on its Arpanet. Today, TCP/IP is used in most large corporate networks to give users access to a wide variety of platforms on different networks. It is also the protocol of the Internet. Enough said.

## ■ Oracle SQL

If any one standard is responsible for the current boom of client/server networking, it's the database language SQL (Structured Query Language). Related to IBM's massive mainframe database DB2, SQL was brought to minicomputers in the late 1970s by the prescient Oracle corporation, which eventually ported SQL down to microcomputer LANs and stand-alone PCs (and even the Sharp Wizard—but nobody's perfect). Oracle's SQL became one of the first truly scalable applications development platforms. You could write and test your application on a workstation and then upscale it to your big iron when it was ready. Or better yet, you could downsize your mainframe apps to less expensive and more efficient systems, like PC networks.

SQL is such a popular standard that today, every major client/server application supports it; no competing architecture has come close.



BOOKS. LOTS AND LOTS OF BOOKS. SOMEWHERE IN THERE IS THE ACTUAL NETWORK 3.11 SOFTWARE. BUT WHERE? WE'LL NEVER TELL.



MANAGING A MESS: HP'S OPENVIEW CONSOLE



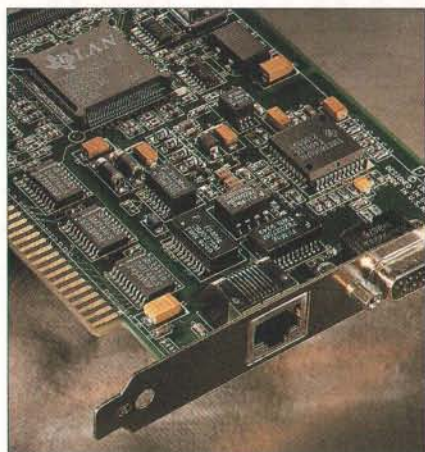
U.B.: HUBBA, HUBBA, EH?



LONG BEFORE PCMCIA, XIRCOM WAS PLUGGING PORTABLES INTO ETHERNET.



# Most Important Networking Products & Standards



WE CAN THINK OF EXACTLY 3270 REASONS THAT ATTACHMATE'S IRMA BOARD, WHICH CONNECTS PCs TO MAINFRAMES, WAS AN INCREDIBLE SUCCESS.

## ■ Group 3 Fax standard

Remember being amazed when a fax machine could transmit a page in less than 30 seconds? That increase in speed was due to the CCITT's Group 3 recommendation for fax transmissions. Issued in 1980, the Group 3 fax standard specified transmission rates of up to 9600 bps and included built-in compression, which made it possible to transmit a typical page in less than 30 seconds.

## ■ Ethernet

Today, when most office workers hear the name Xerox, they think of the photocopier machine, or they erroneously use the corporate name as a verb. We could just as well be using *Xerox* as a term for sending a file down the network wire.

In 1981, Xerox made history by introducing the original Ethernet LAN in the form of its Star Ethernet Series. The LAN was an office system that linked devices, such as workstations, servers, and printers, so that users could share and print documents.

The Star Ethernet Series was the result of Ethernet research conducted by

Xerox with DEC and Intel. It was the first introduction many corporate users got to LAN technology. Xerox was a name player in the office market, and thus its sales staff at least had a foot in the door of most corporations.

## ■ NetWare and Sharenet

In 1981, Novell introduced Sharenet, the first product in the line, which soon became NetWare. It took the simple idea of dedicating one node on a network as a central resource and developed it into the most highly used NOS today.

Novell was not the only company in that newly emerging NOS market. Other early players included IBM and 3Com. But NetWare, especially versions 2.x and 3.x, delivered the features that organizations needed most: solid file and print services.

## ■ Hayes Smartmodem

Before 1981, modems were just plain dumb. They had no memory, and they couldn't recognize commands. The early modems simply did as their name implies: they modulated and demodulated signals.

With the advent of the Hayes Smartmodem in 1981, modems understood and could execute commands (the Hayes AT Commands) on their own.

The Smartmodem and the Hayes command set became the standard for modem communications and made Hayes the dominant player in the market for the next 10 years. Even today, most modem ads still state that the device is Hayes-compatible.

## ■ 3Com Etherlink

In 1982, a small Silicon Valley company cofounded by Bob Metcalfe, the inventor of Ethernet, introduced the first Ethernet adapter card for a PC. The card, the Etherlink, became the best-selling networking product ever. 3Com, Metcalfe's company, also developed its own NOS (network operating system)



with which to use its new creation and drive the sale of its core hardware product.

## ■ The Irma board

The Irma board has to be the one product that symbolizes the acceptance of PCs by the corporate world. Before Irma's introduction in 1982, corporate data, which resided on IBM mainframes, was accessed through 3270 terminals. From these 3270 terminals, users could view data and run applications that printed reports.

In the early 1980s, as PCs started to make their way into corporations, there was a cluttering on the desktop. A terminal and a PC took a lot of room—especially those early IBM PCs with their large footprints.

Technical Analysis, soon to be acquired by Digital Communications Associates (DCA), developed a brilliant solution. Their Irma board, which plugged into a slot in an IBM PC, could give the PC user access to the mainframe data. The board included 3270 terminal emulation software and a coaxial-cable connection on the back to attach to the IBM network infrastructure.

## ■ Streettalk for Vines

Today, many corporations are looking for some way to easily keep track of resources and people on their networks. Ultimately,



# Rack 'em. Stack 'em. Manage 'em.



Six and 12-port hubs combine with 4-port repeater and IN3000/E intelligent module for up to 52 managed ports.

## New Complex hub system.

**M**anaging network growth just got easier. Because with the Complex modular, manageable hub system you can add ports quickly at a surprisingly low cost per port.

Installation is easy, too, because you can stack or rack-mount Complex hubs in a wide variety of configurations up to 52 ports per group.

Combine 6-port Complex TP3000/E and 12-port TP3012/E hubs with the IN3000/E intelligent module and new Complex FreedomView™ network management software that runs on Windows for a

powerful, low cost managed SNMP network.

With the Complex hub system, a network can start small, then grow indefinitely. Unlike



many hub systems, the TP3000/E and 3012/E don't use data ports for expansion, so all ports are available for node connection. Hubs can be cascaded together to form hub groups,



TP3012/E 12-port hub.

which can then be connected with other hub groups via the BNC connector without performance degradation.

Of course, all this performance and versatility has a cost. An amazingly low cost per port!

If you're looking for network growth that's easy and cost-effective, call Complex.



*Out-connecting the rest*

#### U.S.A.

**COMPLEX, Inc.**  
4051 E. La Palma  
Anaheim, CA 92807 U.S.A.  
(714) 630 7302  
Fax (714) 630 6521

#### GERMANY

**ReadyLINK Networktechnology GmbH**  
Albert Einstein Strasse 42  
63322 Rödermark, Germany  
(49) 6074 98017  
Fax: (49) 6074 90668

#### SINGAPORE

**COMPLEX Systems Pte Ltd**  
4 Kim Chuan Terrace,  
Singapore 1953  
(65) 288 8220  
Fax (65) 280 9947



# Most Important Networking Products & Standards



MOSAIC IS LIKE THE FAIRY GODMOTHER OF THE INTERNET, TURNING IT FROM TEXT RAGS TO GRAPHICAL RICHES.

they'll probably use some form of a standards-based directory service, perhaps the ISO's powerful X.500.

In the meantime, they are stuck with stopgap solutions—unless, of course, they are Banyan Vines users. Since 1984, Banyan has offered its users Streettalk, its LAN-based directory services, which are needed in enterprise networks. Streettalk was the first of the enterprise directory services, and some say it is still the best.

## ■ Token Ring

IBM developed token-ring technology in the early 1980s, and the first commercial products hit the streets in 1985. Token Ring was based on the concept of using a token, which was passed around the network, to give a device access to the network. When a device needed to transmit data, it would seize the token. This technique made a token-ring network more deterministic compared with Ethernet's contention-based method for accessing the network.

The deterministic nature of Token Ring quickly became a popular choice for IBM SNA shops and it was quickly adopted by virtually all of IBM's large corporate customers as the way to link users throughout a corporation.

## ■ Cisco AGS multiprotocol router and Proteon Multiprotocol Gateway

These were the first routers to solve the problem of routing different protocols

from and to a single network. Cisco's AGS supported TCP/IP and PUP. Proteon's Multiprotocol Gateway handled ARP, Chaosnet, TCP/IP, and PUP. We would like to award the laurel for first multiprotocol router to either Cisco or Proteon, but the companies are squabbling over who was first. Cisco, a source tells us, has produced the invoice for its first router sale and challenges Proteon to produce an earlier one.

## ■ ISDN

Still don't know? ISDN (Integrated Services Digital Network) is the phone system of the future. Fully digital and quite affordable, it offers enough bandwidth (64 Kbps) for acceptable Internet access and almost enough for videoconferencing. It's also a flexible system, offering scalability up to 1.544 Mbps (not coincidentally the same speed of a T1 line) for corporate sites. The downside of this noble mid-1980s standard is that it's really not standard at all—a lot of telephone markets implement the system differently, so bringing the next generation of communication into your home or business can be an exercise in frustration. Nonetheless, when analog modem technology runs out of steam (as it is beginning to do right now), ISDN will step in as the next great data communications standard.

## ■ Kerberos from MIT

In the mid-1980s, wizards at MIT developed Kerberos, a security system that controls access to network services. Their scheme requires that users be authenticated before they can get to any service on a network. Kerberos does this in an ingenious way. Users gain access to applications, data, printers, and so forth by using the equivalent of an electronic ticket, which is good for only one-time access and which, if the security administrator so desires, can expire within a fairly short time.

The system encloses the access ticket in

an encrypted message using the user's own password. If the user is whom he or she claims to be, the user can decipher the message and the ticket will be available. The user's password is never passed over the network. Security is maintained.

## ■ OpenView

Enterprise network management was easier in the days of homogeneous networks. Companies whose networks were exclusively IBM, for example, would turn to IBM's NetView to manage all the devices on their SNA (Systems Network Architecture) networks.

That was fine until other vendors' products were introduced into a company's network—each with its own management system. Network managers had a deskful of monitors—one for every management system. They had to check the status of different devices on different monitors and assimilate all that information in their head. That was great for the aspirin companies, but for IS managers, it was impractical.

In 1988, Hewlett-Packard introduced Open View to overcome such problems. Open View was the first multivendor network management system. It also offered open APIs. Network equipment vendors could use these programming interfaces to make their products capable of being managed by the system.

## ■ Access/One

Today, virtually all corporate networks are built around intelligent wiring hubs that offer management capabilities and can isolate troublesome cabling flaws. The first commercial network to offer these features was Ungermann-Bass's Access/One hub. Before this, most local networks were made up of daisy-chained components, and a single cable flaw would crash the whole system. Next time you find a flaw that affects only one user and not your entire network, give thanks to Ungermann-Bass.



# Hitachi's new monitors...

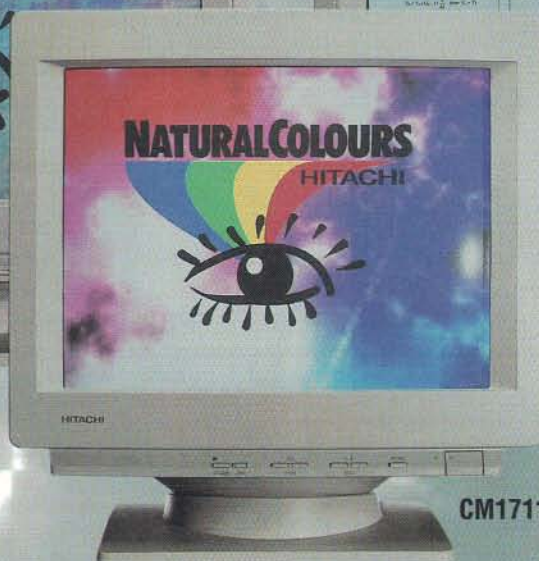
■ Sharpest picture yet! Horizontal pitch of 0.22mm on all models.

■ Eco friendly MPR-II, Nutek and Energy Star compliance.

■ Increased phosphor area means better user control over brightness and contrast.



CM2111M



CM1711M



CM2112MET

■ Microprocessor controls with on-screen displays for easy setup and adjustment.

■ Plug & Play with DDC compliance.

■ Flicker free!

■ New phosphors give wider colour gamut for even greater image fidelity.

Model	Max. flicker free resolution
CM1711M	1280 x 1024 (75Hz)
CM2111M	1600 x 1200 (75Hz)
CM2112MET	1600 x 1280 (80Hz)
	1800 x 1350 (75Hz)



## ...don't buy a PC without one!

Improved technologies and new features mean the sharpest, clearest images, right out to the bezel. You just can't buy better monitors than these - so why accept less with your PC?

**FREE GUIDE!**

We've put together a free guide explaining the technologies which make these new Hitachi monitors so good. For your copy call us now on **0800 605 605**.

# HITACHI

Business Systems Division

Tel: +44 (0)181 849 2092

Fax: +44 (0)181 569 2763

Circle 563 on Inquiry Card.



# Most Important Networking Products & Standards

## Cool Today, Hot Tomorrow

Four technologies stand apart, heralding the coming age of networking.

### LAN Switches

LAN switches handle the heavier traffic that multimedia applications generate on networks by delivering more usable bandwidth to each desktop. They do this without requiring any change to the desktop; users keep their existing Ethernet or token-ring adapter cards in their PCs.

The most useful switching products will be those that can be modified to handle connections to higher-speed networking backbone technologies. While many of the switches already support FDDI (Fiber Distributed Data Interface) and Fast Ethernet connections, the switches that will truly play a major role in corporate networks are those that can accommodate ATM (asynchronous transfer mode) backbone connections.

### Asynchronous Transfer Mode

ATM is the RISC architecture of the networking world: It uses fixed, 53-byte cells. This size is a compromise between the very long packets that would yield the best network performance and the very short frames that would give voice and video the smoothest functioning. Some argue that ATM is a kludge, but it's a kludge showing throughput of 622 Mbps, with future performance in the gigabit range. How far in the future? Considering ISDN's reception, maybe by 2000.

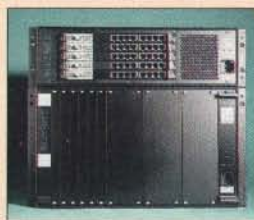
### Voice/Data Integration

With more telecommuters and small offices requiring connectivity to corporate networks, companies are often paying for two lines to each location—one for a telephone and one to carry data. In many situations, the number of access lines to each site could be cut to one if the company could combine the voice and data traffic. Combining the two forms of traffic onto one line is becoming more practical. Some of the standout products making this type of convergence easier include:

- the MMV series of voice/data concentrators from Multi-Tech Systems
- the NetRunner Integration Router from Micom Communications
- the HTMA 200 integrated ISDN and analog modem and the DAS 925 product line from Motorola's Transmission Products Division

### Computer Telephony Integration

For computer telephony integration, successful products will most likely be based on one or both of two approaches. The first is TAPI (telephony API), a programming interface developed by Microsoft and Intel that lets Windows applications access voice services and provides interoperability between PCs and telephone equipment. The second, the Telephony Services API, a programming interface developed by Novell and AT&T, offers a way to connect a PBX to a NetWare server and provides links between PCs and telephone equipment.



SOMETIME IN THE EARLY 1990S, ETHERNET PULLED THE OLD SWITCHEROO, AND ITS PERFORMANCE SKYROCKETED.

### The Sniffer

In 1989, Network General introduced the Sniffer, a single tool that helped network administrators develop and troubleshoot LANs. Today, the Sniffer is synonymous with network analyzers.

The Sniffer offered detailed protocol decoding capability and let LAN managers set traps to watch for certain conditions. It could also capture a trace of all the traffic passing over a LAN segment. These features were (and still are) useful when trying to understand performance problems on a network or when troubleshooting a problem.

### Xircom Pocket Ethernet Adapter

Similar to the way the Irma board symbolized the acceptance of the PC in the corporate world, the Xircom Pocket Ethernet Adapter symbolized the networked arrival of the laptop computer. Xircom had the brilliant idea of using a standard, universally available entry point into the laptop. The company's slick little box plugged into the parallel port—probably the only truly standard PC part. That gave every laptop user a quick and easy way to connect to a LAN.

### Mosaic

The most important reason for the explosive growth of the Internet over the past year is the mass distribution of the Mosaic browser for the World Wide Web. Developed by the University of Illinois' National Center for Supercomputing Applications, Mosaic gives nontechnical people an easy tool with which to find their way around the Internet. Those who could care less about HTTP or HTML (Hypertext Markup Language) can use a Mosaic browser and weave their way through webs of information on their own.

Marc Andreessen and his lesser-known colleagues at NCSA deserve some sort of prize for their efforts. Not only did they invent a brilliant vehicle for navigating the Internet—but they gave it away.



## The Best Things

## On-line

In 1975, the number of people going on-line was smaller than the membership of the Young Republicans for Captain Beefheart Fan Club. Now, those massive networks of computers and databases known as the on-line world have become an electronic extension of the traditional, off-line world.

### ■ Text Search Tools

Information is buried on the Internet. Tunneling its way to fame is gopher. If your site is gopherless, you can Telnet to [consultant.micro.umn.edu](http://consultant.micro.umn.edu) and type *gopher* at the log-in prompt. Even better are WAISes (Wide Area Information Servers). If your system doesn't have a WAIS client, Telnet to [bbs.oit.unc.edu](http://bbs.oit.unc.edu) and type *bbs* at the log-in prompt. Follow the directions.

### ■ Code Talk

Tools, languages, source code, tips and tricks, advice, and folks who've gone through hell. Sound good? Here are some of the best sites. For programming languages, anonymous ftp to [quartz.rutgers.edu](http://quartz.rutgers.edu) and take the path `/pub/computer/languages/*`. For a discussion of the 32-bit Windows API, see the Usenet newsgroup [comp.os.ms-windows.programmer.win32](http://comp.os.ms-windows.programmer.win32). For Unix, post your problem in the Usenet newsgroup [comp.unix.questions](http://comp.unix.questions).

### ■ Internet Directories

If Hercules were around today, one of his labors would be indexing the Internet. Luckily, someone has already done the work. Go to Yahoo at <http://www.yahoo.com>. Or, you can try the WWW (World Wide Web) Virtual Library. It's at <http://www.w3.org/hypertext/DataSources/bySubject/overview.html>.

### ■ Fun & Games

If you want to play in the MUD, see [alt.mud](http://alt.mud), a good introduction to multiuser dimension games. Game Server at the University of Stuttgart provides a huge list. Telnet to [castor.tat.physik.uni-tuebingen.de](http://castor.tat.physik.uni-tuebingen.de) and type *games* at the log-in.

### ■ Technical Support

A Web page that you can visit to get technical assistance sure beats listening to cheesy music when you're on hold. Novell's home page is one of the best examples of how useful a Web site can be. Point your browser at <http://www.novell.com>.

### ■ Web Spelunkers

What if you need to find something on the Web fast? Lycos is from Carnegie Mellon University, and it's hot. Start at <http://lycos.cs.cmu.edu>. WebCrawler is good, too, at <http://webcrawler.cs.washington.edu/WebCrawler/WebQuery.html>. For its part, InfoSeek can pull information from anywhere. But it costs \$9.95 a month. Send E-mail to [info@infoseek.com](mailto:info@infoseek.com).

### ■ Finder of Missing E-Mail Addresses

What if you don't have your recipient's address? Four11 is like an ace detective. To step into its office, E-mail [info@four11.com](mailto:info@four11.com), or point your browser at <http://www.Four11.com>.



LOST? GONE FOREVER? OH, MY! DARLING, DON'T YOU WORRY—SERVICES LIKE LYCOS WILL INDEX AND FIND CLEMENTINE IN A MATTER OF SECONDS.

### The ORIGINAL Burp Gun!



1950's fun is back... The original BURP GUN. It's safe... it's exciting... and it's great for kids of all ages.

This is the original air-powered Burp Gun, the same one that's been produced since the 1950's. Burpco tracked down the original Italian manufacturer and brought the Burp Gun back to the U.S.A. The Burp Gun's proven sales reflect the demand by adults rediscovering the childhood classic. And now, a new generation is discovering the Burp Gun for the first time.

Fun from the 50's is back for kids and grownups, too!

A BURP GUN? EXCUSE ME? ONLY ON THE INTERNET WILL YOU FIND LOVING RESTORATIONS OF SUCH ODDITIES AS THE BURP GUN. SPECIFICALLY, YOU'LL FIND IT (AND NEARLY EVERYTHING ELSE) AT YOUR LOCAL BRANCH MALL.



# The Best Things On-line



BYTE publishes its first issue; articles include "Write Your Own Assembler" and "Recycling Used ICs."

FBI agents capture kidnapped rich-girl-turned-liberation-soldier Patty Hearst.

## ■ Home pages

We like Netscape Communications' page: <http://www.netscape.com>. It's diverse and fun. But for serious computer talk, try the National Center for Supercomputing Applications at <http://www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html>.

## ■ Mailing Lists

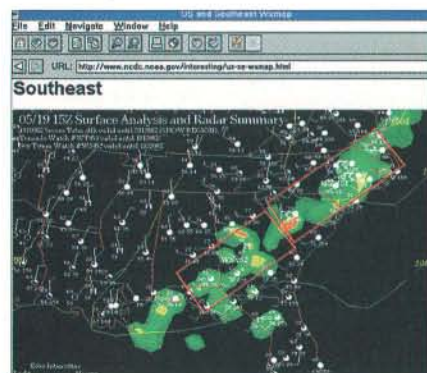
Mailing lists are the most efficient way to get targeted information. An electronic version of Prentice Hall's *Internet: Mailing Lists* book is available via anonymous ftp to <ftp.nisc.sri.com> and follow the path `/netinfo/interest-groups`.

## Yoshiaki Araki's Home Page

Now logging on at 133.27.4.201  
 9/09/10, 1994 at 00:00 (JST), 23:10:34 (GMT)



THE METROPOLITAN MUSEUM AND THE MOMA CAN EAT THEIR HEARTS OUT: THE INTERNET IS HOME TO ELECTRONIC VERSIONS OF SOME OF THE GREATEST ART EVER CREATED.



NO NEED FOR THE WEATHER CHANNEL. JUST TUNE YOUR BROWSER TO THE NATIONAL CLIMATIC DATA CENTER.

## ■ News

Online Today on CompuServe is the most timely source of daily computer news. But Clarinet distributes the *Dilbert* comic strip. Look for newsgroups that start with **clari**.

## ■ Travel Arrangements

With CompuServe, you can make air, hotel, and rental car reservations. Type **GO TRAVEL** and be on your way. On America Online, click on the Travel block.

## ■ Music

If you want to talk about music or keep up with what's new, the Internet's the place. For alternative bands, go to <http://www.juma.com>. Or try out the Music Server: Anonymous ftp to <ftp.uwp.edu>; path is `/pub/music`.

## ■ Financial Information

If you haven't spent all your money on connect time, invest some of it. Clarinet provides the broadest range of financial and business information. **clari.biz.market** gives you the latest on the stock market and **clari.biz.invest** discusses IRAs, mutual funds, and other investment arcana.

## ■ Weather

If you want to know what's going on outside without having to look up from your computer, try the National Climatic Data Center's <http://www.ncdc.noaa.gov/interesting/us-se-wxmap.html>.

## ■ Education Resources

AskERIC, run by the Educational Resource and Information Center, is like a giant help desk for K-12 teachers. The address is [askeric@eric.syr.edu](mailto:askeric@eric.syr.edu), or point your browser at <http://eryx.syr.edu/COWSHome.html>.

## ■ Sounds

If it's been recorded, it's on-line somewhere. Try the Usenet group **alt.binaries.sounds.misc**. And DSP Group's

TsPlayer lets you play a WAV sound file before you download it. Anonymous ftp to <ftp://oak.oakland.edu/SimTel/win3/sound/tsplay100.zip>.

## ■ Free Software

All you have to provide is the shrink-wrap. For PC software, gopher to [merlot.welch.jhu.edu](http://merlot.welch.jhu.edu). For Mac software, anonymous ftp to [oak.oakland.edu](ftp://oak.oakland.edu); the path is `/pub2/macintosh`. You Unix mavens will find a C archive if you anonymous ftp to [wuarchive.wustl.edu](ftp://wuarchive.wustl.edu); use the path `/systems/unix/unix-c/*`. Finally, you'll get OS/2 software at anonymous ftp to [os2.nmsu.edu](ftp://os2.nmsu.edu); the path is `/os2/*`.

## ■ Art

From Mona Lisa to Beavis and Butt-Head, you can get a look at the digitized works of some of the world's greatest artists. Start with ArtMap at <http://wimsey.com/anim/ARTWORLDonline.html>. Then try ArtServe at <http://rubens.anu.edu.au/>.

## ■ Shopping

There's no re-creating the mall experience. Thank God. Start at the Branch Mall at <http://branch.com>. AutoPages is the place to shop for that new Lamborghini. Speed on over to <http://www.clark.net/pub/networkx/autopage/autopage.html>.

## ■ Talk to Computer Companies

CompuServe's company forums are still the best places to tell vendors what you think, to talk with company officials. Join the Hardware and Software Forums for starters—most major companies have support forums on CIS.



### Reliability you can depend on

In 1994, Sentinel improved its industry leading reliability to over 99.985% – far more reliable than any other software protection product.

### The industry's highest quality

Rainbow is the world's *only* software protection supplier with ISO 9002 certified quality standards.



### Manage network licenses

NetSentinel™ is the *only* protection to undergo rigorous testing by and receive approval from Novell.

### Truly transparent protection

Designed to go unnoticed by your customers, Sentinel does not interfere with hardware, peripherals or other software programs.

### A substantial investment in R&D

In 1994 alone, Rainbow invested over \$4,500,000 in R&D to make the world's leading software protection even better.

### Compatible with your software

Our partnerships with Apple, Microsoft and IBM mean Sentinel protects software for any hardware or operating system.

### Global service & support

Rainbow supports its customers with offices and distributors in more than 40 countries.



Product is shown larger than actual size. In fact, the SentinelSuperPro™ is the world's smallest dongle.

### Total security & flexibility

Sentinel keys are available with proprietary ASIC technology, multiple EEPROM cells or even a microcontroller – giving you the world's best software protection.



# Why this dongle protects more software than all others combined!

Over 6,500,000 Sentinel® keys protect software worldwide. In fact, 55% of all protected software has a Sentinel key, from Rainbow Technologies.

Today, software piracy is at an all-time high. If you're selling software without protection, you're losing sales and revenue.

Start protecting your software investment. Stop software piracy

with Sentinel, then watch your sales and profits increase.

**Discover the Sentinel difference**  
Sentinel is easy to implement, transparent to your end-users, and backed by the world leader. When you need on-time delivery and global support, you need Sentinel.

*Only* Sentinel gives you leading-edge technology, ISO certified quality and over 99.985% reliability.

**Protect your software investment**  
Order a *Sentinel Developer's Kit* now. Each kit comes complete with technical documentation, software drivers, utilities, and a Sentinel key.

Call the Rainbow office or distributor nearest you today.



## SENTINEL

Software Protection



**WORLD HEADQUARTERS:** 50 Technology Drive, Irvine, CA 92718 ■ Tel: 714/450-7300 ■ Fax: 714/450-7450  
**ASIA/LATIN AMERICA:** 714/450-7300 ■ **U.K.:** (44) 1932 570066 ■ **FRANCE:** (33) 1 41 43 2900 ■ **GERMANY:** (49) 89 32 17 98 0  
**VISIT THE RAINBOW TECHNOLOGIES HOME PAGE AT:** <http://www.RNBO.COM>

**ARGENTINA:** Agri-Aid, S.A. 54 1 8030536  
**AUSTRALIA:** LOADPLAN 61 3 690 0455  
**BELGIUM/LUXEMBURG:** E2S 32 92 21 11 17  
**BRAZIL:** MIPS Sistemas Ltda. 55 11 574 8686  
**BULGARIA:** KSIMETRO 35 9279 1478  
**CHILE:** ChileSoft Ltda. 56 2 2327617  
**CHINA (Eastern):** Shanghai Pudong Software Park Development Company 86 21 4371500

**CHINA (Northern):** CS&S 86 10 8316524  
**COLOMBIA:** Construdata 57 1 610 7500  
**CZECH REPUBLIC:** ASKON Int'l 42 2 3103 652  
**GREECE:** Byte Computer S.A. 301 924 17 28  
**HONG KONG:** Computers & Peripherals 852 2515 0018  
**HUNGARY:** Polyware Kft. 36 76 481 236  
**INDONESIA:** P.T. Promptrade InfoScan 62 21 375 166  
**IRAN:** GAM Electronics 98 21 22 22374

**ITALY:** BFI IBECSA SPA 39 23 31 00535  
**ITALY:** Siosistemi 39 30 24 21074  
**JAPAN:** Giken Shoji Co., Ltd. 81 52 972 6544  
**JORDAN:** CDG Engineering 96 26 863 861  
**KOREA:** Genesis Technologies 82 2 578 3528  
**LEBANON:** National Group Consultants 961 1 494317  
**MALAYSIA:** Eastern Sys. Design (M) Sdn Bhd 60 3 241 1188  
**MEXICO:** Impex Comp., S.A. de C. V. 52 66 210 291

**MIDDLE EAST:** Hoche Int'l 44 81 459 8822  
**MOROCCO:** Futur & Soft 212 2 40 03 97  
**NETHERLANDS:** IntroCom 31 74 430 105  
**PHILIPPINES:** Mannasoft Tech. Corp. 63 2 813 4162  
**POLAND:** HITEX Sp. z o.o. 48 22 41 97 51  
**PORTUGAL:** COMELTA 351 1 941 65 07  
**SCANDINAVIA:** Perico A/S 47 2249 1500  
**SINGAPORE:** Systems Design PTE LTD 65 747 2266

**SPAIN:** MECCO 34 3 422 7700  
**SWITZERLAND:** IBV AG 41 1741 2140  
**SWITZERLAND:** Safe Compaid S.A. 41 2421 5386  
**TAIWAN:** Evershine Tech. 886 2 8208925  
**THAILAND:** BCS Int'l 66 2 319 4451  
**TUNISIA:** ASCI 216 1 781 751  
**TURKEY:** BIMEKS, Ltd. 90 216 348 3508  
**VENEZUELA:** HRT-M Osers 58 2 261 4282



# Generally Speaking,



**T**here was a time you could find anything you needed at a general store. Nowadays Gateway 2000® can offer you that same neighborly service and wide selection of quality products.

We care about our customers. That's why Gateway offers a large assortment of cutting-edge, quality, professional desktop systems. Whether you need a solid 486 workstation or the power of the P5-133XL — we can help you out. Stocked with the latest technology, the P5-133XL includes a 133MHz Intel Pentium processor, 16MB EDO performance-enhanced memory, 256K pipelined burst cache, Matrox MGA Millennium graphics accelerator with 2MB WRAM, and MS Office 95 Professional Edition upgrade upon release. Plus you'll receive a three-year on-site warranty and priority toll-free technical support 24 hours a day, seven days a week with our new Gateway Gold Premium Service, standard only on the P5-133XL!

Gateway also has a Grade A inventory of portable PCs as diverse as our desktop line. At 4.2 pounds, the Liberty DX4-100 Base system is chock-full of features like an Intel 100MHz DX4 processor and 10.4-inch display. It's the perfect partner for your desktop PC, and when you're off for parts unknown. Our shelves are full of tantalizing options that include expanded RAM, lithium ion batteries, external CD-ROM drives, huge hard drives, fax/modems and PCMCIA network cards to satisfy any PC buyer's taste.

Times may change, but Gateway 2000's tradition of providing high-quality, feature-packed computers remains the same. And by ordering now, you'll reserve your copy of Microsoft's new operating system, Windows 95. Call Gateway today and talk to *your* friends in the business.



# We Have It All



intel  
inside  
pentium  
PROCESSOR

## P5-133XL

- Intel® 133MHz Pentium® Processor
  - Intel Verified: Upgradable
  - 16MB EDO Performance-Enhanced Memory
  - 256K Pipelined Burst Cache
  - 1.62GB Mode 4, 9ms IDE Hard Drive
  - PCI Enhanced IDE Interface
  - Matrox® MGA™ Millennium™ Graphics Accelerator w/ 2MB WRAM
  - 4X 3-CD Changer, 16-Bit Ensoniq® Wavetable & Altec® ACS-31 Speakers w/ Subwoofer
  - TelePath™ 28.8 Fax/Modem Communication Center
  - 3.5" Diskette Drive
  - 17" .26dp Vivitron™ Color Monitor
  - 9-Bay Tower Case
  - 101-Key Keyboard & MS Mouse 2.0
  - MS-DOS® 6.22, WFW 3.11
  - Microsoft® Windows® 95 and Office 95, Professional Edition Upgrades
  - MS Office Professional 4.3, Bookshelf® & Money 3.0
  - Gateway Gold™ Premium Service
- \$3999**



## LIBERTY™ DX4-100 BASE

- 4.2 Lbs., 10" x 8" x 1.6"
  - 10.4 DSTN Color Display
  - 8MB RAM
  - Removable 340MB Hard Drive
  - 1MB Video RAM
  - Choice of Desktop IR Receptor or External Floppy Drive
  - Intel 100MHz 486DX4 Processor
  - Instant On
  - NiMH Battery & AC Pack
  - 2 PCMCIA Type II Slots
  - EZ Point™ Integrated Pointer
  - 78-Key Keyboard
  - Parallel, Serial, VGA & PS/2® Ports
  - OAG® FlightDisk®, World Clock, & Ascend® personal information manager (PIM) for use w/ Franklin Day Planner® by Franklin Quest™ Co.
  - MS-DOS 6.22, WFW 3.11
  - Microsoft Windows 95 Upgrade
  - MS Works for Windows 3.0
- \$2999**



Gateway Liberty DX4-100 Gateway Liberty DX4-100



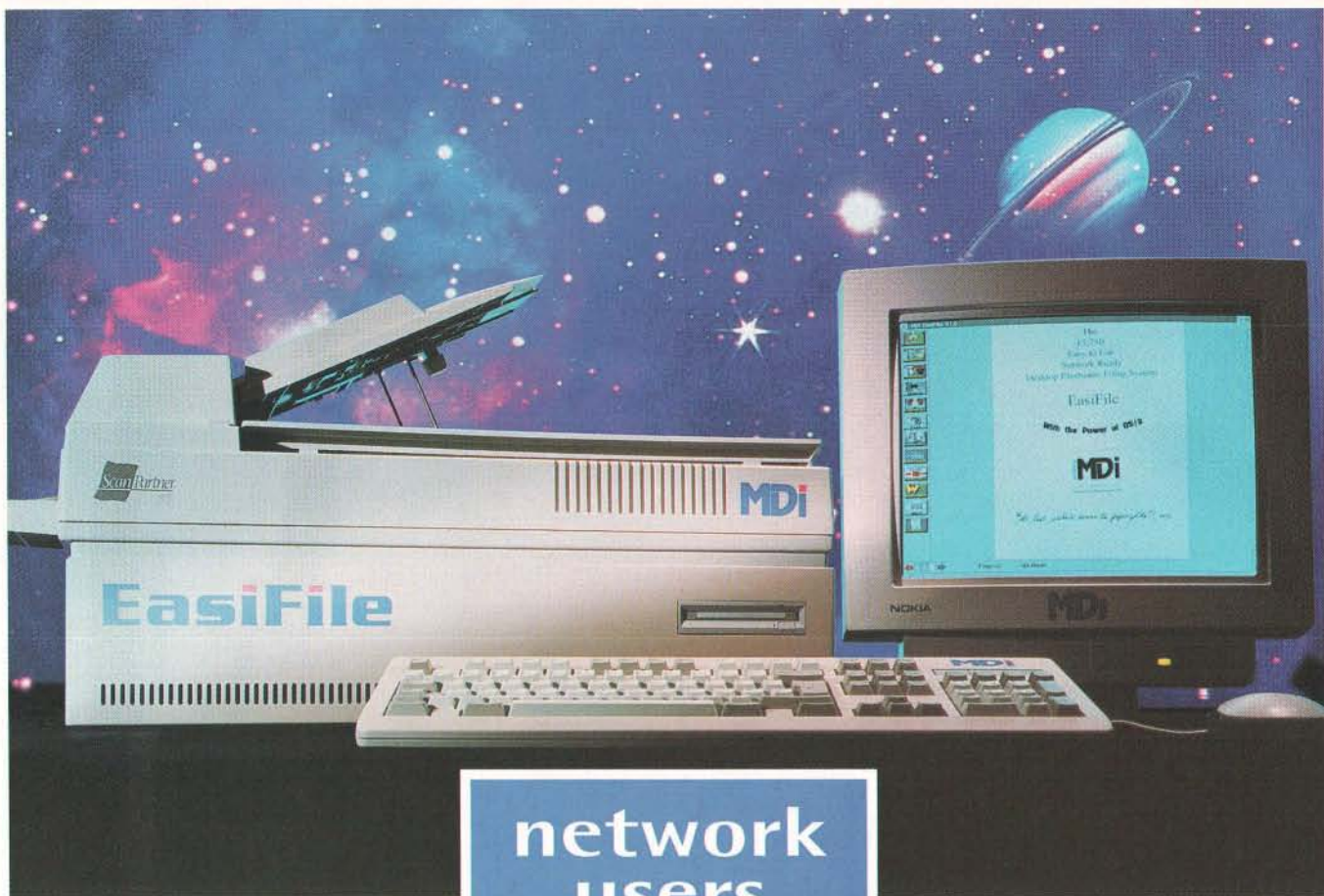
**General Sales 800-846-2058 • Portables 800-846-4289**

610 Gateway Drive • P.O. Box 2000 • N. Sioux City, SD 57049-2000 • Phone 605-232-2000

TDD 800-846-1778 • Fax 605-232-2023 • FaxBack 800-846-4526

International FaxBack Access 605-232-2561 • Sales Hours: 7am-10pm Weekdays, 9am-4pm Saturdays (CDT)





## network users conquer time and space.

Be honest. As a technology leader people look to you for new ideas and innovative solutions. You've been successful. Now you have responsibilities. Demands on your time keep increasing. Your office never seems to be quite large enough. It's almost as if time and space have shrunk around you. You're cool except, that is, when you can't find something, then you go completely stark raving bonkers!

Now at last a tool that is really going to help you. We call it EasiFile.

EasiFile is a complete network-ready electronic filing system. Designed to give you instant retrieval of all your paper based information, however vast. EasiFile deals with the very documents you find so difficult to file and find. Technical articles, CVs, reports, product specs, news releases, bills, even cherished letters from old friends can be scanned and stored quickly with fully automatic or structured indexing. With EasiFile you are master of your own information.

Because your time is so precious, we have designed EasiFile as a total solution. From the moment you open the box it's ready to work for you. Everything you need is included, pentium based

system unit, network interface, scanner, optical storage, monitor, keyboard, mouse and, of course, the software.

With our software, forget wait states. Scan, compress, display images, write to optical disk at once thanks to our multi-threaded, multi-tasking, application. At last, a product that shows the power of OS/2. EasiFile systems can be configured to run on virtually any

network, including, LanServer, Novell, DECnet and TCP. Sharing paper documents with colleagues on the network has never been easier than with EasiFile.

MDi started in a Scottish garage in 1989 and have risen to supply some of the World's top companies with document management solutions. Now our technology and experience is available to you in a system that is easy to use, available worldwide and does not cost the earth.

So why not give us a call on our free phone number or surf over to us on the Net. We believe this will be the best time investment you ever make.

**CALL FREE ON 0800 37 11 86**

**Callers outside the UK should call (44) 1368 850 650.**

**Worldwide Web <http://www.mdisystems.co.uk/easifile>**

**email: [easifile@mdisystems.co.uk](mailto:easifile@mdisystems.co.uk)**

**MDi Systems Limited,  
Newmains, Stenton, Dunbar,  
Scotland EH42 1TQ UK.**

Tel: (44) 1368 850 678 Fax: (44) 1368 850 679

Systems  
**MDi**

**Resellers Wanted  
Worldwide**

**Circle 282 on Inquiry Card.**

**US RESELLERS: EAST COAST:** Intelisys Technologica Inc. Tel: (703) 356 9803 Fax: (703) 356 9805 **WEST COAST:** 2M Invest Inc. Tel: (415) 655 3765 Fax: (415) 372 9107  
**CENTRAL:** REMTEK Tel: (214) 387 2855 Fax: (214) 387 3342 email: [edremtek@metronet.com](mailto:edremtek@metronet.com) **ASIA AND PACIFIC RIM:** MDi Ltd. Tel: (852) 2545 0567 Fax: (852) 2543 4666



# BEST Books & CD-ROMs

These are the books and CD-ROMs that have advanced the state of computing, that best chronicle the past two digital decades, and that manifest the innovative use of electronic publishing. Read on.

## BOOKS

### ■ The Art of Computer Programming

Donald E. Knuth

(Addison-Wesley, 1973–1981)

The bible of all fundamental algorithms and the work that taught many of today's software developers most of what they know about computer programming.

### ■ The Cuckoo's Egg: Tracking a Spy Through the Maze of Computer Espionage

Clifford Stoll

(Doubleday, 1989)

Astronomer Stoll notices a tiny accounting error and ends up catching a spy in this real-life thriller. *The Cuckoo's Egg* is much more than your basic thriller, though; it raises extremely important questions about international on-line ethical behavior, which is an important issue in the information age.

### ■ Fluid Concepts and Creative Analogies: Computer Models of the Fundamental Mechanisms of Thought

Douglas Hofstadter and the Fluid Analogies

Research Group

(Basic Books, 1995)

Whether you agree with Hofstadter's concepts or not, he has moved the AI debate beyond mere rhetoric to actually writing programs that can test the AI hypothesis.

### ■ Fumbling the Future: How Xerox Invented, then Ignored, the First Personal Computer

Douglas K. Smith and Robert C. Alexander

(William Morrow, 1988)

A sad tale of a company that comes up with so many brilliant ideas but lets them die in the R&D labs.

### ■ Hackers: Heroes of the Computer Revolution

Steven Levy

(Anchor Doubleday, 1984)

The best book there is about the unconventional brainiacs and code wizards who started it all.

### ■ Inside the IBM PC

Peter Norton

(R. J. Brady, 1983)

The Master of Utilities rolls up his sleeves and produces the first popular book to expose the innards of IBM's personal computer. One of the best tutorials on what's inside the box.

### ■ Programming Windows 3.1

Charles Petzold

(3d edition, Microsoft Press, 1992)

In its time, it was the ultimate guide for Windows applications developers.

### ■ The Soul of a New Machine

Tracy Kidder

(Little, Brown, 1981)

A true-life engineering adventure story.

### ■ Unauthorized Windows 95: Developer's Resource Kit

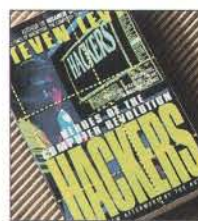
Andrew Schulman

(IDG Books Worldwide, 1994)

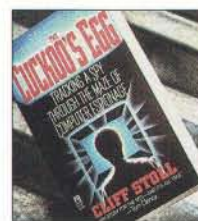
What makes Windows 95 tick? Not only does Schulman tell developers about the code behind Windows 95, he tells them what decisions and trade-offs Microsoft made.



STILL KIDDERING AROUND AFTER ALL THESE YEARS.



SOME WENT ON TO BECOME MILLIONAIRES. SOME WENT DIRECTLY TO JAIL.



INSIDE YOU'LL FIND A GREAT RECIPE FOR CHOCOLATE-CHIP COOKIES. REALLY.



# BEST Books & CD-ROMs

## ■ Understanding Computers and Cognition: A New Foundation for Design

Terry Winograd and Fernando Flores  
(Ablex, 1986)

One of the first books that explores for a large audience how computers fit into—and change—our lives.

## CD-ROMS

### ■ Cinemania

Microsoft

A must for movie lovers. Great for settling trivia debates. Summaries of more than 19,000 films, from contemporary to classic. Updated annually. Nothing like it exists in book form. Many thumbs up.



THESE ARE THE VOYAGES OF THE STARSHIP ENTERPRISE—YOUR VOYAGES, THANKS TO SOME ASTOUNDING VIRTUAL REALITY.



TANGLED UP IN BIG BLUE: DYLAN'S NEW HIGHWAY 61 INTERACTIVE CD-ROM FOR THE PC.

### ■ Computer Select

Ziff Communications

Do you need to research a computer product or get a feel for what's hot? Do you want to find the printed buzz on a particular piece of hardware or software?

Computer Select is the easiest way to search the full text of 28 computer magazines and abstracts from 110 other periodicals. Updated monthly.

### ■ Compton's Interactive Encyclopedia for Windows

Compton's Learning Co.

The best interactive encyclopedia keeps getting better. Maps, charts, animations, high-resolution pictures, and an easy-to-use interface bring the printed version's 32,000 articles to life.

### ■ Highway 61 Interactive

Graphix Zone

When you're lost in the rain in Juarez, and it's Easter time, too, turn on this disc to see just how good a CD-ROM can be. A Bob Dylan multimedia museum.

### ■ Mayo Clinic Family Health Book

IVI Publishing

Helps you understand anatomy, diseases, and health issues. Provides the full text of the 1378-page printed version, plus 500 narrated illustrations. Uses animations and video clips to explain basic physiological concepts. Has a slick morph-like animation of human anatomy.

### ■ McGraw-Hill Science and Technical Reference Set, release 2.0

McGraw-Hill

From the company that owns BYTE, this disc contains McGraw-Hill's *Concise Encyclopedia of Science and Technology* and the unabridged McGraw-Hill *Dictionary of Scientific and Technical Terms*. Your technical library just isn't complete without it.



### ■ Microsoft Bookshelf

Microsoft

Tons of information at your fingertips, with some of it illuminated by audio and graphics. Includes *The American Heritage Dictionary*, *Roget's Thesaurus*, *World Almanac*, *The Hammond Intermediate World Atlas*, the *Concise Columbia Encyclopedia*, and the *Columbia Dictionary of Quotations*. Updated annually.

### ■ Myst

Broderbund Software

A fantastic fantasy game with great graphics, animation, music, and entertaining (if diabolical) puzzles. The first CD to bring a new kind of art to our society.

### ■ Star Trek: The Next Generation Interactive Technical Manual

Simon & Schuster Interactive

Apple's QuickTime VR panoramic video technology lets you explore the starship *Enterprise* and the entire Federation as never before possible.

### ■ Taxi

Middlegate

Before you go to New York, Los Angeles, San Francisco, Chicago, and Washington, D.C., check out Taxi. It lets you create personalized city maps for the above cities, including Zagat Survey reviews and ratings of hotels and restaurants. Information becomes more important when it's personalized to your needs.





There's only one thing  
about our computer  
that's not in keeping  
with industry standards.

The performance.

Indy Modeler. The affordable CAD/CAM/CAE solution.

There's one computer in the market that runs all major CAD/CAM/CAE software, supports network standards like TCP/IP, Netware™ and NFS™, comes standard with SoftWindows™ and innovative workgroup collaboration software, and gives you incredibly powerful 3D modeling performance.

Indy Modeler™

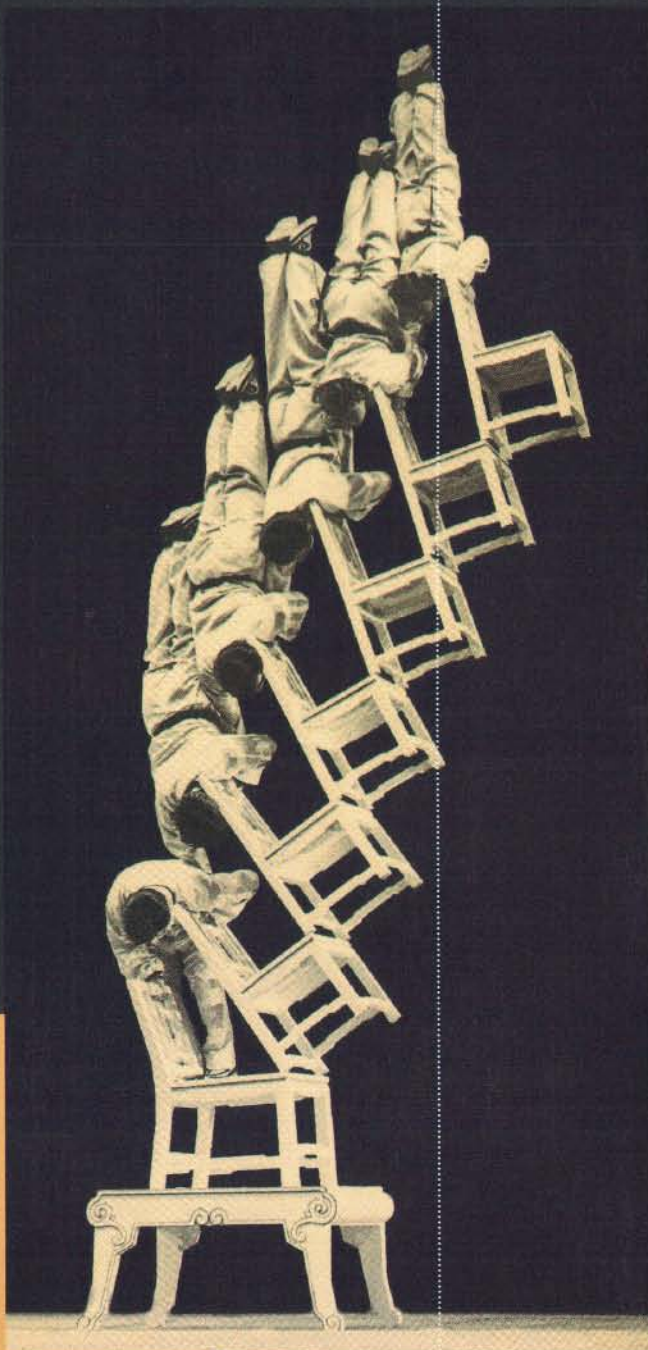
So it's hardly surprising that it won the AIM Benchmark award for best price/performance in its class.

Indy Modeler runs all major software including Pro/Engineer™, Pro/JR™, AutoCAD® R13, SDRC-I-DEAS Master Modeler™, Matra Datavision-Prelude and MicroStation Modeler™.

For copies of the Indy Modeler brochure and video, and the name of your nearest reseller, call 1-800-636-8184, Dept. D440, or visit us on the World Wide Web at <http://www.sgi.com/Works>.

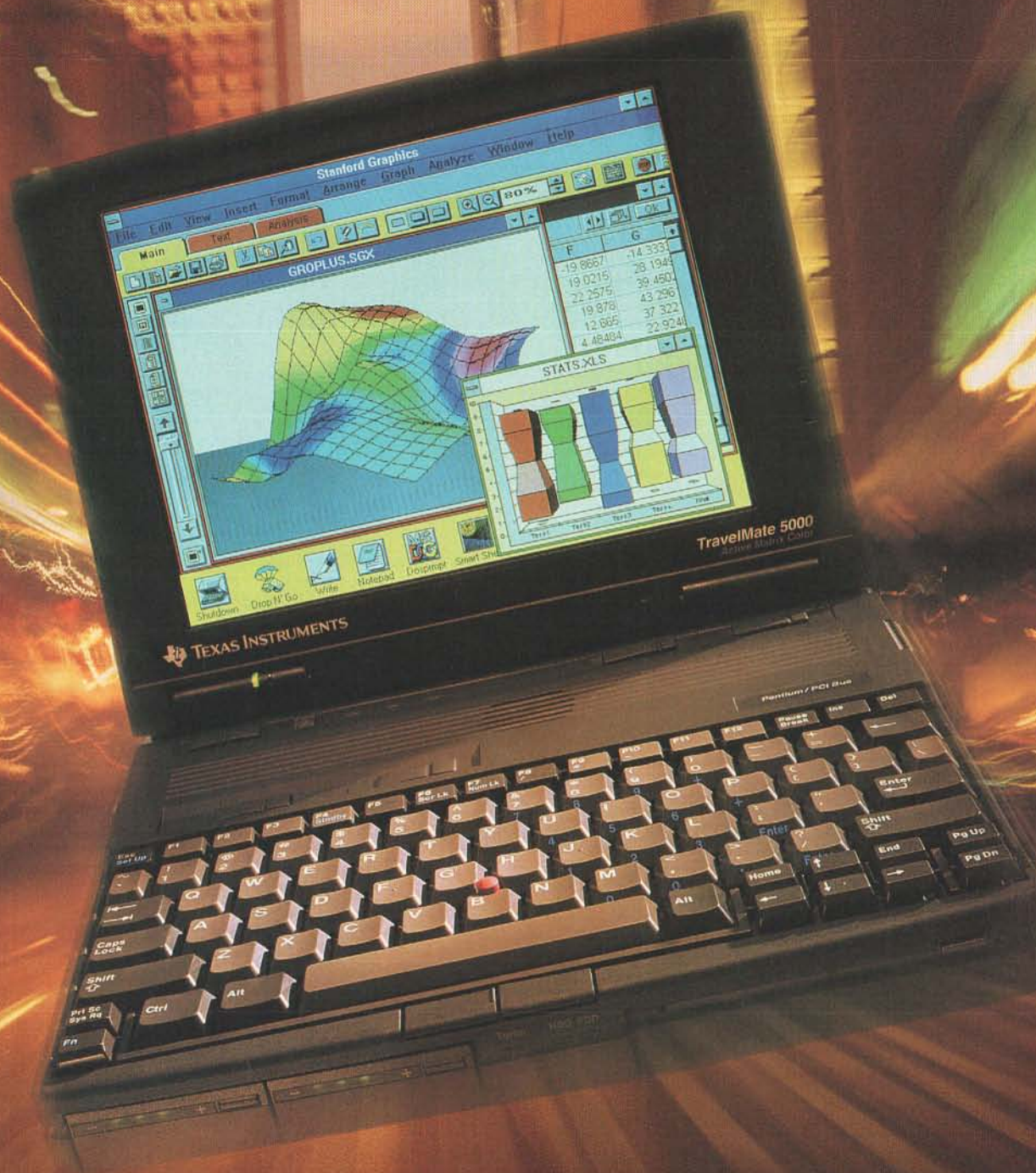


© 1995 Silicon Graphics, Inc. All rights reserved. Silicon Graphics is a registered trademark, and Indy, Indy Modeler and see what's possible are trademarks of Silicon Graphics, Inc. Netware is a trademark of Novell. NFS is a trademark of Sun Microsystems. SoftWindows is a trademark of Inghnia. Pro/Engineer and Pro/JR are trademarks of Parametric Technology Corporation. AutoCAD is a registered trademark of Autodesk, Inc. I-DEAS Master Modeler is a trademark of SDRC. MicroStation Modeler is a trademark of Bentley Systems, Inc. Screen image courtesy of Intergraph Corp.



see  
what's  
possible





## The New Texas Instruments TravelMate™ 5000

• 75 MHz Pentium processor • Two Lithium ion battery packs • Serial infrared port • 10.4" Active Matrix or 10.5" Dual Scan displays • 524 million bytes (=500MB) or 810 million bytes (=772MB) Hard Disk Drives\* • 8MB RAM, expandable to 32MB • 2MB Video memory • Multimedia package: Built-in 16-bit sound, internal speaker & dual mode microphone





# Introducing The First Notebook To Maximize The Pentium Processor's Full Potential.

When the rush was on to introduce a notebook with a Pentium® processor, Texas Instruments decided to do what others thought couldn't be done.

We created a notebook that maximizes Pentium performance by integrating *full PCI bus architecture* in our TravelMate 5000.



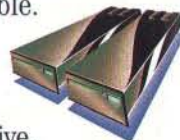
And for flexible connectivity, we designed a way to allow external access from the PCI bus to the latest peripherals.

It was a challenge we addressed for two simple reasons: to give users true desktop Pentium performance for *faster running software and expansion capabilities* for investment protection.



So now you have a notebook with *smoother full-motion video and enhanced 3-D graphics*. In addition, we designed the TravelMate 5000 to take advantage of the "plug and play" capabilities of Windows 95® when it becomes available.

But our engineers didn't stop there. *We added a second lithium ion battery* without sacrificing size, weight or eliminating a floppy drive.



In addition, wireless communication with other notebooks and desktops is very quick and easy with our integrated infrared capabilities.

*The TI TravelMate 5000.* For more on what others thought you couldn't do with a notebook, call 1-800-TI-TEXAS (e-mail: [2ti@msg.ti.com](mailto:2ti@msg.ti.com) or on the Internet: <http://www.ti.com>).

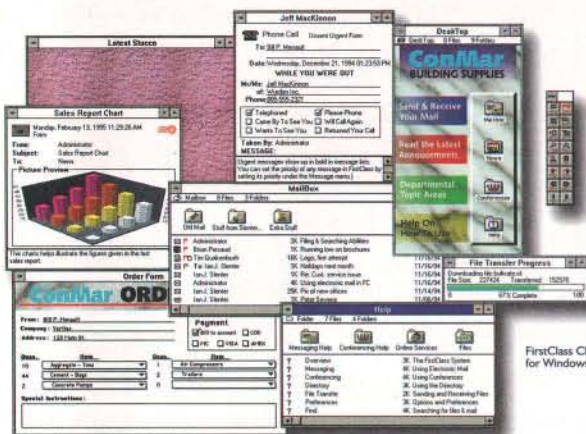
EXTENDING YOUR REACH™



Warranty may vary from country to country. Contact your local TI office for details. Batteries and options are covered by a one year limited warranty. \*Depending on model. TravelMate and "Extending Your Reach" are trademarks of Texas Instruments. Windows 95 is a registered trademark of Microsoft Corporation. The Intel Inside Logo and Pentium are registered trademarks of Intel Corporation. © 1995 TI.

Circle 247 on Inquiry Card (RESELLERS: 248).





## Reliable, Scalable Client/Server Communication. FirstClass Delivers — Now.

# FirstClass®

Not only is SoftArc's FirstClass client/server e-mail and groupware product available today — but it's used by more than three million people in twelve languages worldwide.

Other electronic mail vendors are still struggling with client/server architectures. SoftArc's FirstClass has offered the industrial-strength messaging that sites like yours demand, combined with group collaboration and remote access ... all since 1991.

FirstClass integrates full fledged electronic mail with workgroup discussion databases. Communicate elegantly with individuals or groups with the world's easiest, cross-platform graphical mail interface.

Administer multi-server FirstClass networks from a single location. Synchronize directories between sites. Add powerful Internet gateways for instant global communication. Offer news feeds or collaborative areas for workgroups. Connect with other mail systems and technologies, including faxes and PDAs.

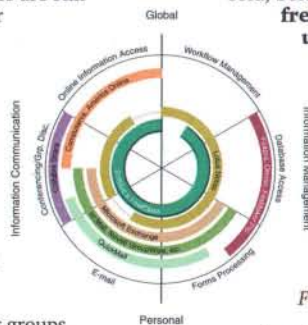
FirstClass also offers access to enterprise databases, interface customization and outstanding remote connectivity ... all for the price of traditional e-mail.

Finally, even after three million users sold, SoftArc continues to offer **free technical support** and **unlimited free upgrades** to registered owners of FirstClass.

Discover why more and more organizations like yours have chosen FirstClass — a proven, real-world messaging infrastructure.

For more information, or a free FirstClass demonstration package, call **1-800-SOFTARC**.

Traditional e-mail doesn't address group communication. Conferencing and groupware systems lack real e-mail. FirstClass offers both ... and more.



1995 MacLife Japan Grand Prize  
1994 MacUser Best New Communication Product Finalist  
1994 Dataquest Sweden Editor's Choice Networking Software  
1994 MacUser UK Editor's Choice Networking Software  
1993 MacUser Best New Communication Product  
1993 BYTE Award of Merit  
1993 Macworld Germany E-Mail Product of The Year



**FirstClass  
Server available  
for Windows NT  
or Macintosh**



**SoftArc Inc.**  
Global Area Communications

1902 Ridge Road, #325, West Seneca, New York, 14224  
Phone: 905-415-7000 Fax: 905-415-7151 info@softarc.com

Circle 262 on Inquiry Card.



# Remarkable Names of Real Computer Companies



SLIPPERY DISKS



PLAID BROTHERS SOFTWARE



SURFCAM, INC.

## ■ Techie Founder Division

PropellerHead Software  
Two Nerds and a Suit  
TechnoJock Software, Inc.

## ■ High Self-Esteem Division

Famous Engineer Brand  
Software  
Right Answers, Inc.  
Simply Outstanding Software

## ■ Divinely Inspired Division

Exodus Software  
Promised Land  
Technologies, Inc.  
Software Heaven

## ■ Natural Competitor Division

Dragon Systems, Inc.  
DragonSlayer Systems

## ■ Animal Division

Groundhog Graphics, Inc.  
Gecko Group  
Grizzlyware

## ■ What's the Concept? Division

Paradigm Concepts, Inc.  
Treacyfaces, Inc.  
Bio-Plum, Inc.

## ■ Home on the Range Division

Whiskey Hill Software  
Double R Software, Inc.  
Rancho Technology, Inc.

## ■ Clinton Administration Division

Algor, Inc.  
Hillary Software, Inc.

## ■ PUNitive PUNishment Division

Slippery Disks  
O'Pin Systems, Inc.  
CADapult, Ltd.

## ■ Spelling Checker Division

Konpyuta Software PS, Inc.  
Cykic Software, Inc.  
Aamazing Technologies, Inc.

## ■ A Certain Life-Style Division

SurfWare, Inc.  
No-Brainer Software, Inc.  
Relax Technology

## ■ Modesty Division

Functional Software  
Plain Jayne Software, Inc.  
Working Software, Inc.

## ■ New Words Division

Mathemaesthetics, Inc.  
BehavHeuristics, Inc.  
Pectronics Corp.

## ■ Science and Math Division

3rd Planet Software, Inc.  
Calculus, Inc.  
Entropy, Ltd.

## ■ Literature Division

Ozymandias Engineering  
Utopia Grokware, Inc.  
Bloomsbury Software  
Group, Inc.

## ■ Mythology Division

Odin Systems, Inc.  
Prometheus Products, Inc.  
THOR Computers

## ■ Negative Connotations Division

Glacier Software  
Screaming Technology, Inc.  
Missing Link Technologies

## ■ Living Color Division

Plaid Brothers Software  
Beige Bag Software  
Cobalt Blue, Inc.

## ■ Fruit and Vegetable Division

Electric Banana, Inc.  
Okra Marketing Corp.  
Radish Communications  
Systems, Inc.

## ■ Mineral Division

Night Diamonds Software  
Onyx Computing, Inc.  
Sapphire Systems, Inc.

## ■ Uncategorizable Division

Grumpfish, Inc.  
Boojum Computer  
Systems, Inc.  
Gunning Wordnology

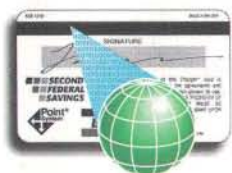


PRESENTING THE  
**PHOTON™  
microGUI**  
AT THE EMBEDDED SYSTEMS CONFERENCE  
Booth 1433



# The Leading Realtime OS for PCs

So you've chosen Intel® processors for your embedded systems. Smart choice, given the great variety of form factors, buses, and software support for non-desktop PCs. Now go with the leading realtime OS for PCs.\*



With QNX's successful 14-year track record and huge installed base, you can count on a realtime OS that's been proven time after time in the real world.

**Scale it on the Fly** As a modular, microkernel-based OS, QNX lets you add or subtract modules to fit your platform—from PDAs up to workstations equipped with X and TCP/IP. You can start and stop modules at run time *without rebooting your system!* Even our runtime pricing is modular, so you pay for only the OS modules used in your target systems.

**Open Embedded Systems** QNX is the *certified* POSIX OS that performs like a dedicated realtime executive. You get the rich API and tools of an open-systems OS, all in a scalable package that can fit on everything from tiny ROM-based systems to vast distributed LANs.

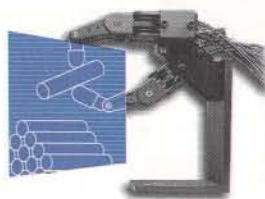
You'll like the tighter, faster code you get with the Watcom C/C++ optimizing compiler.

Not to mention the time you'll save with our distributed debugger, profiler, and trace analysis tools.

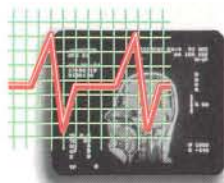


## Embeddable GUI

And if you're looking for a full-featured windowing system in a very small package (under 300 K), look no further than Photon™, the world's first microkernel GUI for embedded systems.



**Embedded and Distributed** Beyond mere connectivity, QNX provides true distributed processing. Your embedded system can become part of a fault-tolerant network with resources you can control from any PC throughout the LAN. Whether you're doing remote debugging, or accessing X applications from a PDA, it's all remarkably easy with QNX.



**From PC/104 to PCMCIA** QNX runs on several buses—PC/104, STD, STD 32, VME—and embedded PCs from Adastral, Ampro, Octagon, Xycom, Radisys, Teknor, VMIC, WinSystems, and Ziotech. We also support the i386EX processor, as well as industry standards such as PCI and PCMCIA.

To find out more about the leading realtime OS for PCs, contact us at [info@qnx.com](mailto:info@qnx.com) or <http://www.qnx.com> or call

**800-676-0566. (EXTENSION 1007)**

- **Leading in Experience** (Realtime OS for PCs since 1981)
- **Leading in Innovation** (Microkernel distributed OS for PCs since 1984)
- **Leading in Market Share** (QNX outsells every other realtime OS for PCs)

QNX Software Systems Ltd., 175 Terence Matthews Crescent, Kanata, Ontario, Canada K2M 1W8 Voice: 613-591-0931 Fax: 613-591-3579 Email: [info@qnx.com](mailto:info@qnx.com) Web: [www.qnx.com](http://www.qnx.com)  
Europe: 17 Bishops Court, Church Road, Bishopstoke, Hampshire, SO50 6PE, England Voice: (+44) 1703 611800 Fax: (+44) 1703 641153 Email: [QNXeurope@qnx.com](mailto:QNXeurope@qnx.com)

\*According to a recent report by Emerging Technologies Group, QNX has "the largest realtime operating system marketshare in the Intel® 80X86 marketplace."  
© QNX Software Systems Ltd. 1995. QNX is a registered trademark and Photon is a trademark of QNX Software Systems Ltd. All other trademarks belong to their respective owners.

Circle 238 on Inquiry Card.



# Most Important Companies

Which of the 5000 computer companies got us where we are today? Here are the top 20.

## ■ Adobe Systems

As if inventing and commercializing PostScript weren't enough, Adobe also developed most of the tools of the desktop publishing revolution: Photoshop, Illustrator, and, of course, scalable fonts; and it acquired Aldus PageMaker, the program that practically defined desktop page layout. Adobe's influence in document production has grown from the desktop to the prepress shop. It has also reached into other creative domains: Its Premiere video-editing suite could be the training studio for the Martin Scorseses of digital cinema. John Warnock and Charles Geschke have been steering the company through the foggy nightscape of electronic documents. Whether or not Acrobat will become the interchangeable document standard, as PostScript did for printing, it has made a permanent mark on desktop publishing and computer graphics.

## ■ Apple Computer

This might be something to argue about, but you could make a good case that Apple has had more influence on personal computing than any other company. Who personifies the industry, the culture of personal computing, more than Woz the electronics whiz and Jobs the dynamo salesman—the engineer and the entrepreneur—hopping with ideas, quitting their day jobs, working in a garage, and selling a VW microbus to finance the company?

The affordable Apple II turned thousands of people on to computing. Then came the Mac, for years the computer that Intel-based PCs wanted to be when they grew up, with its graphical interface, built-in networking, and plug-and-play design. As it's done for nearly 20 years—something very few clone makers can say—Apple continues to influence the state of personal computing.

## ■ AT&T

Its attempts to build personal computers have never been anything to call home about. (Can you remember the PC 6300? Did you ever even hear of it?) But AT&T has contributed three things of monumental importance to computing: Unix, the phone system, and the cumulative genius of the researchers at Bell Labs. Even those tedious "You Will" ads can't overshadow these significant accomplishments.

## ■ Autodesk

CAD on a personal computer? You've got to be kidding. But John Walker and his 12 programming disciples weren't. When they started Autodesk in 1982, their objective was a PC software package that would provide 80 percent of the functionality of a mainframe CAD system at 20 percent of the price. Later that year, they shipped AutoCAD. It couldn't do everything a mainframe program could, but it was good for the kinds of things most designers do. Plus, it was affordable—you no longer had to be Boeing to have a CAD system. Today, with a million copies sold and versions across all major platforms, AutoCAD is the uncontested champ of desktop CAD. Other companies have built better, easier-to-use, less expensive CAD programs—but every



AN ARTIST'S REPRESENTATION OF MICROSOFT HEADQUARTERS (IT COULDN'T BE REAL—IT'S NOT RAINING).



HARVARD UNIVERSITY, MIT, AND THE TASTY: ALL CONTRIBUTING PEOPLE AND KNOWLEDGE TO LOTUS.



# Most Important Companies

one of them has one thing in common: the AutoCAD file format. More than anything, that says Autodesk defined PC CAD.

## ■ Borland International

In 1983, a year of major announcements—the XT, NetWare, Windows—one of the biggest splashes, a Pascal compiler for \$49.95, was made by this obscure company. Turbo Pascal wasn't just cheap. It was fast, and it was good. With one successful ad in BYTE, Turbo Pascal launched Borland into the stratosphere of micro software companies. More important, it made Pascal programming affordable. Borland killed the notion that languages and programming tools had to be expensive to be good. In 1987, with Quattro Pro, they did the same for spreadsheets, substantially undercutting the price of Lotus 1-2-3. Maybe Borland should have concentrated

on programming tools—like its recent Delphi—instead of getting caught up in price wars and Lotus lawsuits. Regardless, Borland tools have been adopted by a generation of developers, and the company's impact on software prices has been good for users.

## ■ Commodore International

Commodore's role as a personal computing pioneer is sadly overshadowed by its business failures. But along with Apple and Tandy, it was one of the 1977 Trinity: the three companies who brought out ready-to-run PCs. The Commodore PET had a built-in monitor, a tape drive, and a bargain price of \$795. Then came the VIC-20, the industry's first million seller. No wonder; it was a color computer that cost less than \$300. The string of hits continued with the Commodore 64. Not only was it possibly the biggest seller of all time, it was the first with a synthesizer chip. Then, in 1985, came the world's first multimedia PC: the Amiga, a classic example of a product ahead of its time. Besides design innovations, Commodore's other big contribution can be summarized by the slogan of its founder, Jack Tramiel: "Computers for the masses, not the classes."

## ■ Compaq Computer

Houston, Texas, February 1982: Three men sit in the House of Pies kicking around a product idea. A year later, their newfound company would ship the Compaq Portable. (They shipped 53,000 of them that year.) The computer in the famous sewing machine case could run all the software developed for the IBM PC. It became the benchmark of PC compatibility. Because of its dedication to solid engineering, Compaq also became the benchmark of quality. Even True Blue shops learned to trust the brand. Compaq made it OK to buy a clone. Other clones sold for less, but if you bought a Compaq, you knew you didn't have to hold your breath and cross your fingers every

time you fired up Lotus 1-2-3. Plus, you could carry the thing home. (Does that mean we should blame Compaq for the extension of the workday?) Did those three guys in the pie shop know how big their PC clone idea would become?

## ■ CompuServe

Much of what we expect on an on-line service, we expect because we saw it on CompuServe: forums, vendor support, free software, newswires, and E-mail to everywhere; business and personal services; reliable global communication; and most recently, access to the Internet. CompuServe turned the switch on-line in 1979 and now claims more than 2.5 million users. For a good portion of the PC public, CompuServe is what it thinks of when it thinks of going on-line.

## ■ Digital Equipment Corp.

If DEC founder Ken Olsen had had his way, the company probably wouldn't be on this list. After all, this is the man who said, essentially, that the destiny of home computers was in the closet. Despite Olsen's antiquarian contrarian attitude, Digital made some significant contributions to personal computing—especially networking in academic environments. Once it acknowledged the personal computer as a business machine, it proceeded wholeheartedly to produce superb networking equipment; today, it's a leading hub vendor. Digital also helped advance Ethernet and FDDI, and it developed the spanning tree bridging algorithm that many large companies used to build their enterprise

15  
YEARS  
AGO IN  
BYTE

Tandy introduced its TRS-80 Model III.

The U.S. Supreme Court ruled that the public has a right to attend criminal trials.



COURTESY OF APPLE COMPUTER, INC.



SILICON VALLEY'S NUMBER ONE AMUSEMENT PARK: THREE FLAGS OVER CUPERTINO.



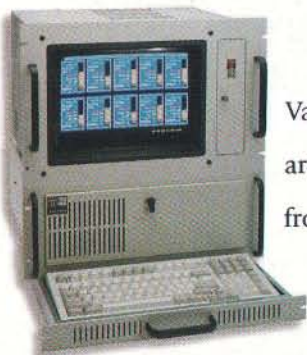
ARMONK? WHOEVER HEARD OF HEADQUARTERING A COMPANY IN ARMONK? FOR THAT MATTER, WHOEVER HEARD OF ARMONK?



# Finally, a rackmount that's right on the money.



## The ValuePro Rackmount Very Affordable.



ValuePro rackmounts aim high on performance, and are right on target with prices you can afford. Choose from 16 models which feature a variety of Pentium™

or 80486 CPU cards, with a host of other features that make standard PCs miss the mark. And ValuePro prices are right

on the money, too. For information on ValuePro rackmounts, or our other products for industrial computing, contact us today.

### 1-800-627-8700

Fax: 713-541-8226 • Phone: 713-541-8200 • E-mail: [sales@texmicro.com](mailto:sales@texmicro.com)

Visit us on the web: <http://www.texmicro.com>

Circle 272 on Inquiry Card (RESELLERS: 273).

**Rush The Info To Me!**

Name:

Company:

Address:

City, ST, Zip:

Phone:

Fax this ad directly  
to: 713-541-8226. We'll  
show you how ValuePro  
rackmounts are right on target!

**TEXAS  
MICRO**  
A Sequoia Company



# Most Important Companies

**WEIRD ERROR MESSAGE NO. 4**

**>HAPPY BIRTHDAY!**

(sole response from a malfunctioning motherboard)

networks before multiprotocol routers began to adopt other algorithms.

## ■ IBM

Why does everyone make fun of IBM's failures? It's the butt of more jokes than Rodney Dangerfield's wife. But in 1981, the computing giant brought out the IBM PC. IBM might as well have called it the DFS, for de facto standard. If that doesn't earn the company a place in history, then consider these inventions: the Winchester disk drive, the floppy disk drive, and the laser printer. In some ways, you might also put Microsoft on IBM's list of inventions.

## ■ Intel

All those millions of x86 chips; the dominant computing architecture; the Pentium franchise. Any questions?

## ■ Lotus Development

People thought it was crazy when upstart Lotus announced it was bringing out a spreadsheet program. VisiCalc was king. But Lotus had a good idea—combining worksheet, calculation engine, and graphics functions into one product. And Lotus had the brilliance to go after the next big thing instead of fighting for the current big thing. That next big thing was the IBM PC. Lotus developed its spreadsheet program for IBM's machine, not the Apple II. Smart move. For the next decade, Lotus owned the spreadsheet market. Even though competitors have taken away a big share, those competing products all look suspiciously like Lotus 1-2-3. Whether or not Lotus can

dominate with its innovative Notes software remains to be seen (IBM surely thinks so), but its investment in this groupware technology shows traces of the foresight that inspired the creation of Lotus 1-2-3.

## ■ Microsoft

Once upon a time, these two guys wrote a version of BASIC for microcomputers. Then they acquired this OS, which they renamed MS-DOS. Then they made this once-in-a-lifetime deal with IBM. Then they sold millions of copies of Windows. Then they ruled the world. The End.

## ■ Motorola

Galvin Manufacturing Corp. helped make car radios ubiquitous in the 1930s. Forty years later, under the name it used to brand those mobile radios—Motorola—the company helped make semiconductors ubiquitous. Its 6800 chip inspired the inexpensive 6502 (developed by ex-Motorola engineers who had defected to MOS Technology) that Steve Wozniak picked to be the brain of his new computer. Later, Motorola's influence was more direct: Apple could afford the 68000 series for the Macintosh.

## ■ Novell

Other companies also came up with software to connect personal computers, but Novell was smart enough to design an open network OS with hooks. It was willing to work with other parties to enhance the system. While partners were developing extra goodies, Novell focused on the core OS. It got out of the hardware business and concentrated on its sure thing: connectivity software. The result is NetWare's position as the king of NOSes (network OSes), the means by which millions of PCs are connected.

## ■ Shugart/Seagate

When Shugart Associates brought out its 5-MB 5¼-inch hard drive in 1980, the com-

pany started something as big as the drive's capacity seemed to be: the idea that personal computer users could have their own massive storage device, right there, at a reasonable price. Five megabytes—how could you ever fill that much space? Four years earlier, Shugart had introduced another breakthrough: the 5¼-inch minifloppy for \$390. The company also originated the concept that became SCSI; in 1979, it proposed a general-purpose expansion bus called Shugart Associates System Interface, which eventually became an ANSI standard known as SCSI-1.

Alan Shugart went on to head Seagate, today one of the leading makers of hard disks. Seagate has continued the Shugart tradition of innovations in storage technology. By the end of this year, you'll be able to buy a 1-GB drive for \$300. This kind of low-cost, high-capacity storage is the legacy of Shugart and his engineering team at Shugart Associates.

## ■ Sun Microsystems

Sun set out in 1982 with an objective that the big guys scoffed at: to build powerful, affordable, personal workstations for scientists and engineers. And it was going to build them from off-the-shelf parts and use a powerful OS with available source code—Berkeley Unix. Early on, Sun realized the importance of built-in networking. And its SPARC architecture is one of the most successful RISC designs in history. Although it has seen competition from high-end PCs, Sun has responded by steadily pushing down the costs of its workstations. It must be doing something right. Today, Sun controls at least a third of the workstation market, and its systems are finding lots of work as Internet servers.

## ■ Tandy

Tandy was one of the three companies to ship a ready-to-run personal computer in 1977 (along with Apple and Commodore). The TRS-80 came with a monitor and



# ECEL's ECS-series Booksize Computer

*With the solutions to meet your needs.*

10" color STN LCD  
640×480 resolution

10" VGA color CRT monitor

2×16 bit expansion slots  
for FAX or LAN card

Book size case dimension:  
315×225×70mm

Internal 60W  
power Supply

## CPU

Intel Pentium® processor-75MHz  
Intel Pentium® Processor-90MHz  
Intel Pentium® Processor-100MHz

## Display

VGA 32-bit local (VL) Bus  
1MB Video DRAM  
10" color STN LCD 640×480  
640 color VGA compatible. or  
10" VGA color CRT monitor

## Power system

Internal 60W power Supply

## I/O slots

2×16-bit ISA expansion slots

## Dimension

315×225×70mm

## Floppy Disk Drive

3.5" 1.44MB Floppy Disk Drive

## Fixed Disk Drive

2.5", 19mm max. height removable  
HDD, local bus IDE interface

## Power Management Feature

System management mode (SMM)  
Build-in Intelligent Power Manager

## I/O Interfaces

One Parallel port  
Two Serial ports



## Cache memory

Build-in 256KB second level Cache

## BIOS

AMI or Award BIOS

# ECEL

ECEL SYSTEMS CORP.  
8F-3, NO. 27, LANE 135, SEC. 1,  
FU-HSING S. RD.,  
TAIPEI, TAIWAN, R.O.C.  
TEL: 886-2-752-6670  
FAX: 886-2-772-3407  
TLX: 13323 GOODFOLD

DIGICOM EUROPE B.V.  
WAGENMAKERSTRAAT 7 2984 BD  
RIDDERKERK THE NETHERLANDS  
(HOLLAND)  
TEL: 31-1804-11888  
FAX: 31-1804-19815

The Intel Inside® logo and Pentium® Processor are trademark of Intel Corporation.

Circle 526 on Inquiry Card (RESELLERS: 527).



20th ANNIVERSARY  
1974-1994  
**BYTE**

# Most Important Companies

Microsoft BASIC, so you could start programming right away. Tandy's large retail network helped establish personal computers as products you could buy anywhere. All you had to do was walk into one of the 3000 Radio Shack stores with \$600 in hand. Although some of the company's executives couldn't see it, true believers at Tandy knew that computers were most powerful when in the hands of individuals. The TRS-80 was one of the seeds that grew into the PC industry. The little wonder known as the Model 100 could be safely described as one of the first laptops. By building low-cost machines, and with help from its enthusiastic, gospel-spreading users, Tandy helped popularize microcomputing.

## ■ WordPerfect

OK, so it doesn't score well on the Vision-O-Meter. Four years after Michael Shroyer invented Electric Pencil, the first word processor for micros, and a year after Seymour Rubinstein came out with WordStar for the PC, WordPerfect (then called Satellite Software) was working on a word processor for Data General machines. When the company woke up to the personal computing phenomenon, it apparently didn't sleep again for years—too busy bringing out new versions for multiple platforms and grabbing market share in a crowded market. WordPerfect grew to be the world's dominant word processor, with an impressive user base estimated at 5 million.

## ■ Xerox PARC

This place ought to be called Brainiac City. Xerox's PARC (Palo Alto Research Center) has been home to some of the most brilliant scientists and idea generators in computing. Many products we take for granted today started out as concepts in the mind of a PARC scientist—e.g., the graphical interface, networking, the book-size computer, bit-mapped displays, and visually oriented programming languages. Today, PARC continues exploring new ways of using and operating computers as well as experimenting with very-high-resolution screens, environments that imitate physical space, and user interfaces radically different from the PARC-bred point-and-click approach.



**1-800-238-7272**

**Para Systems, Inc.**  
1455 LeMay Drive  
Carrollton, Texas 75007  
214/446-7363  
Fax: 214/446-9011

Product and company names mentioned herein may be trademarks or registered trademarks of their respective companies.

## BEFORE YOU BUY A UPS COMPARE...

Smart purchasing decisions are made based on facts, whether you're buying a car or a UPS. Before you buy a UPS, take a few seconds to make the comparison yourself. The facts will show that Minuteman's Alliance Series provides more features for less money. It's as simple as that.

To further stand behind our promise of more features for less money, Minuteman has established an industry-leading 10-part Smart Buyer Program that will provide you with a price protection guarantee, a competitor's trade-in discount plan, free technical support, along with other important guarantees. To top it off, we'll even beat any competitor's price on an equivalent VA-rated line-interactive UPS. Call our Power Hotline now for more detailed information on our Smart Buyer Program. Be smart, buy smart ... and make sure it's a Minuteman UPS.

**MAKE THE COMPARISON FOR YOURSELF**

Model	Minuteman A300	APC BK780	Tripp-Lite BC150	Model	Minuteman A500	APC BP420	Tripp-Lite Dual Pro 450
<b>PRICE</b>	\$139	\$139	\$139	<b>PRICE</b>	\$259	\$299	\$279
Price per Watt	.73	.81	.79	Price per Watt	.86	1.15	1.00
Audible Alarm	YES	YES	NO	Line Interactive	YES	YES	YES
LED Status Indicators	3	0	2	LED Status Indicators	4	4	4
Test Button	YES	NO	NO	Test Button	YES	NO	YES
Self Diagnostic Test	YES	NO	NO	Self Diagnostic Test	YES	NO	YES
Site Wiring Fault Indicator	YES	YES	NO	Site Wiring Fault Indicator	YES	YES	YES



Circle 232 on Inquiry Card (RESELLERS: 233)



# ECEL's Powerisers 7600-series Notebook Computer

*With the solutions to meet your needs.*



## CPU

- Intel Pentium® processor-75MHz
- Intel Pentium® processor-90MHz
- Package: SPGA

## Main Memory

- 8 MB On-board DRAM
- Expandable to 16 MB/24 MB/40 MB

## Cache Memory

- Built in 256KB second level cache

## Display

- VGA 32-bit local (VL) Bus architecture
- 1 MB video DRAM
- LCD Panel: with 640×480 resolution
  - \* Dual San STN Color: 10.3"
  - \* TFT Color: 9.4" or 10.3"

## BIOS

- 128 KB AMI Flash ROM BIOS

## Fixed Disk Drive

- 2.5", 19mm max, height removable HDD
- Local bus IDE interface
- Average Access Time: below 17ms

## Floppy Disk Drive

- 3.5", 1.44MB Micro Floppy Disk Drive
- 3-mode supported for Japanese model

## Audio system

- Built-in 16-bit stereo Audio Card
  - \* Windows Sound System compatible
  - \* Sound Blaster Compatible
  - \* Mic-in. speaker-out and volume control
- Built-in Speaker and Microphone

## PCMCIA Interfaces

- PCMCIA 2.0 Standard Compliant
- Two PCMCIA type II or one type III slots

## I/O Interfaces

- One EPP/ECP compliant Parallel Port
- One 16C550 compatible serial port
- One 15-pin External Monitor connector
- One external PS/2 Keyboard Connector
- One 200-pin local bus Docking Station connector

## Pointing Device

- Built-in 19-mm Trackball
- COM2 interface

## Power system

- AC Adapter
  - \* Compact size (145×60×42mm)
  - \* 90 to 240 volts. full range AC Adaptor
  - \* 2-hour Fast Charge
- Battery Pack
- NiMH Battery Pack
- Battery cell: 12 long A size cells
- Battery Life: over 2 hours

# ECEL

**ECEL SYSTEMS CORP.**  
8F-3, NO. 27, LANE 135, SEC. 1,  
FU-HSING S. RD.,  
TAIPEI, TAIWAN, R.O.C.  
TEL: 886-2-752-6670  
FAX: 886-2-772-3407  
TLX: 13323 GOODFOLD

**DIGICOM EUROPE B.V.**  
WAGENMAKERSTRAAT 7 2984 BD  
RIDDERKERK THE NETHERLANDS  
(HOLLAND)  
TEL: 31-1804-11888  
FAX: 31-1804-19815

The Intel Inside® logo and Pentium® Processor are trademark of Intel Corporation.

Circle 528 on Inquiry Card (RESELLERS: 529).



# 111 reasons why we changed our name and logo.

<i>Business Week</i>	<i>S&amp;P Outlook</i>	<i>Dodge DataLine<sup>2</sup></i>
<i>Business Week International</i>	<i>S&amp;P Trendline</i>	<i>Dodge Market Leader</i>
<i>Business Week Online</i>	<i>S&amp;P ComStock</i>	<i>Dodge LeadTime</i>
<i>Business Week Strategic Programs</i>	<i>S&amp;P Compustat</i>	<i>Sweet's Group</i>
<i>Schaum</i>	<i>GLOBAL Vantage</i>	<i>Sweet's Catalog Files</i>
<i>College Publishing</i>	<i>J.J. Kenny Drake</i>	<i>SweetSource</i>
<i>Shepard's/McGraw-Hill</i>	<i>McGraw-Hill Municipal Screen</i>	<i>Aviation Week &amp; Space Technology</i>
<i>CTB (California Test Bureau)/McGraw-Hill</i>	<i>Kenny S&amp;P Information Services</i>	<i>Aviation Week Group Newsletters</i>
<i>Glencoe/McGraw-Hill</i>	<i>Blue List</i>	<i>B/CA &amp; A/C Flyer</i>
<i>London House</i>	<i>KENNYBASE</i>	<i>World Aviation Directory</i>
<i>Macmillan/McGraw-Hill School Division</i>	<i>KENNYCONNECTS</i>	<i>BYTE</i>
<i>McGraw-Hill School Systems</i>	<i>Standard &amp; Poor's CUSIP Service Bureau</i>	<i>Data Communications</i>
<i>SRA (Science Research Associates)/McGraw-Hill</i>	<i>Kenny S&amp;P Evaluation Services</i>	<i>Data Communications International</i>
<i>SRA Technology Training</i>	<i>MMS International</i>	<i>Datapro Information Services</i>
<i>McGraw-Hill Home Interactive Software</i>	<i>MMS FOREX Express</i>	<i>National Software Testing Laboratories</i>
<i>McGraw-Hill Continuing Education Center</i>	<i>S&amp;P Securities, Inc.</i>	<i>Northern Business Information</i>
<i>McGraw-Hill Grupo Iberoamericano</i>	<i>Primis Custom Publishing</i>	<i>LAN Times</i>
<i>McGraw-Hill Interamericana de España</i>	<i>Platt's</i>	<i>Open Computing</i>
<i>McGraw-Hill Interamericana de Mexico</i>	<i>Standard &amp; Poor's Ratings Services</i>	<i>The Physician &amp; Sportsmedicine</i>
<i>McGraw-Hill Health Professions Division</i>	<i>Corporate Ratings</i>	<i>Postgraduate Medicine</i>
<i>McGraw-Hill Healthcare International</i>	<i>Financial Institutions Ratings</i>	<i>Hospital Practice</i>
<i>Osborne Books</i>	<i>Public Finance Ratings</i>	<i>Chemical Engineering</i>
<i>McGraw-Hill Professional &amp; Reference Books</i>	<i>International Ratings</i>	<i>Electrical Power International</i>
<i>Tab Books</i>	<i>Insurance Ratings</i>	<i>Electrical World</i>
<i>McGraw-Hill Ryerson Limited Canada</i>	<i>Structured Finance Ratings</i>	<i>Energy &amp; Business Newsletters</i>
<i>DRI/McGraw-Hill</i>	<i>S&amp;P Publishing Services</i>	<i>Environmental Engineering World</i>
<i>Standard &amp; Poor's</i>	<i>CreditWeek</i>	<i>Modern Plastics</i>
<i>S&amp;P Equity Investor Services</i>	<i>KERO-TV (Bakersfield)</i>	<i>Modern Plastics International</i>
<i>S&amp;P 500 Index</i>	<i>KGTV (San Diego)</i>	<i>Power</i>
<i>S&amp;P MidCap 400 Index</i>	<i>KMGH (Denver)</i>	<i>Utility Data Institute</i>
<i>S&amp;P SmallCap 600 Index</i>	<i>WRTV (Indianapolis)</i>	<i>Tower Group International</i>
<i>S&amp;P Municipal One Million Index</i>	<i>Architectural Record</i>	<i>TowerNet</i>
<i>S&amp;P MarketScope</i>	<i>Construction News Publishing Network</i>	<i>Tower Group International Canada Inc.</i>
<i>S&amp;P Stock Guides</i>	<i>Engineering News-Record</i>	<i>UCB Canada Inc.</i>
<i>S&amp;P Corporation Records</i>	<i>F.W. Dodge</i>	<i>TransGlobal Logistics</i>
<i>S&amp;P Stock Reports</i>	<i>Dodge Reports</i>	<i>TradeRef</i>
<i>S&amp;P Research Reports</i>	<i>Dodge Bulletins</i>	<i>Global Finance</i>

PRESENTING



## The McGraw-Hill Companies

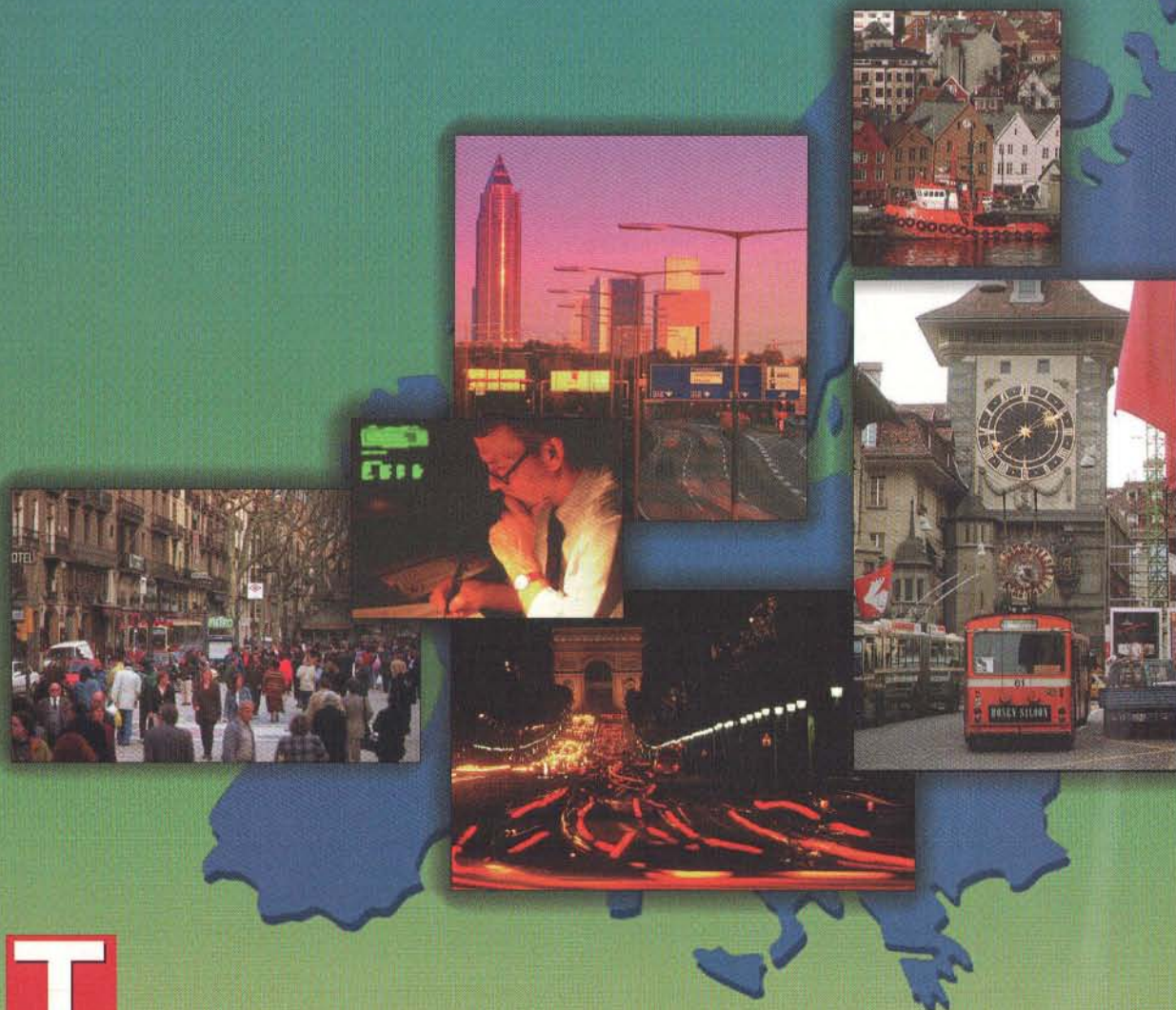
If you're surprised by the extent of the McGraw-Hill brands and companies listed above, then you'll understand why we've included them in our name. The change reflects the breadth of our respected businesses and our growing commitment to the diverse strengths of our people. It also expresses our pride in being a leading information

services organization, offering valuable analysis and knowledge to worldwide markets through a broad range of traditional and electronic media. While we will always embrace the McGraw-Hill values of high quality and editorial integrity, our new name serves as a reminder that we are equally dedicated to looking ahead.

*Financial Services • Information and Media Services • Educational and Professional Publishing*



# BYTE's Pan-European Postcard Deck Targets Influential European Technology Experts



**T**he BYTE EURO-DECK offers a unique direct mail approach to increasing sales in the \$114 billion European computer market. Reach 50,000 BYTE subscribers for under 4¢ per reader!

Circulation of the BYTE EURO-DECK is targeted to computer experts in over 20 countries in Western Europe. Take full advantage of the benefits BYTE provides

with this affordable, direct channel to Europe. For information on the next BYTE EURO-DECK, call Joseph Mabe at 603/924-2533 or fax to 603/924-2683.

**BYTE**  
**EURO**  **DECK**



SERVERS • RAID • STORAGE



THE SAG TOWER OF POWER

# BUILT TO ORDER

*High Quality Custom-Configured Systems At Off-The-Shelf Prices*

**Precision Engineered Power Systems!**—SAG file servers are built with precision and offer features like multiple processing, disk mirroring, RAID 5 fault tolerance—plus more storage capacity at prices the competition just can't beat. Affordable Disk Arrays, Tape Backup Solutions and RAID 5 Technology from SAG Electronics "The High-End Solutions Company."

**We've Outclassed the Competition!**—SAG incorporates the highest quality components in all its systems like MICRONICS motherboards, ADAPTEC controllers and Seagate, Quantum & Micropolis hard drives. Performance, reliability and customer satisfaction is what we're all about. We are the only vendor to offer fully configured custom engineered servers and storage solutions.

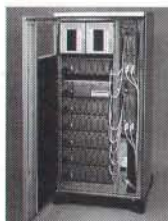
**Compatibility Guaranteed! Expert Software Services Available!**—All our systems are guaranteed to work with your operating software. We provide expert services on OS/2, SCO, Novell, and Windows NT operating systems.

**Buy Direct from SAG Expert Technicians!**—SAG expert technicians and knowledgeable sales personnel can configure a custom solution to meet both your technical and financial requirements. We have been satisfying the technical demands and needs of our customers since 1987.

AUGUST 1995  
**BYTE**  
BEST OVERALL  
INTERNET SERVER  
BYTE/NSL REPORT



Top Honors  
Internet File Server



SAG TERABYTE



PC RACK MOUNT SOLUTIONS



STACKABLE  
MODULAR DRIVE  
SOLUTION



DUAL MOTHERBOARD  
16-BAY 400 WATT  
REDUNDANT POWER

## GRAPHICS POWER STATION 133MHZ

IMAGINE 128, FASTEST,  
GRAPHICS, DRIVE, AND  
MOTHERBOARD

- 1 INTEL 133 MHZ PENTIUM
- 256K PIPELINE SRAM CACHE
- TRINTRON CHIPSET "EDO MEMORY OPTION"
- 16MB RAM EXPANDABLE TO 128MB
- SLOTS: (4) PCI, (4) ISA
- ADAPTEC 2940W, SONY 4X CD-ROM
- #9 IMAGINE 128-BIT GRAPHICS 4MB VRAM
- 4GB 7200RPM SCSI WIDE
- MICROSOFT MOUSE, 101 KEYBOARD
- WINDOWS 95
- MINTOWER

**\$3989**

## ALPHA 275MHZ

- 2MB CACHE

- 1 DEC 275 ALPHA CPU
- 64MB RAM EXPANDABLE TO 512MB
- 4x CD ROM SCSI
- 4GB 7200 RPM DRIVE SCSI WIDE
- #9 IMAGINE 128 BIT GRAPHICS
- 12 BAY 300 WATT POWER
- WINDOWS NT

**\$9399**

## RAID 5 SERVER DUAL 100MHZ SMP

- 1 INTEL PENTIUM 100 MHZ CPU
- 512K CACHE
- 16MB RAM EXPANDABLE TO 512MB
- 3 TWO GB, 8MS HARD DRIVES
- RAID 5 CONTROLLER
- SLOTS: (3) PCI, (5) EISA
- 12 BAY TOWER, 8 REMOVABLE, AND HOT SWAPPABLE
- TWO 300 WATT REDUNDANT POWER SUPPLIES
- KEYBOARD AND 1.44 FLOPPY

**\$6895**

## DUAL 133 MHZ SMP MULTIPROCESSOR

- DUAL 100MHZ & 90 AVAILABLE
- 2 INTEL 133MHZ PROCESSORS
- 512K CACHE
- 32MB RAM EXPANDABLE TO 512K
- 4GB 7200 SCSI WIDE
- SLOTS: (3) PCI, (5) EISA
- SONY 4X CD ROM SCSI
- ADAPTEC 2940W
- #9 2MB PCI VIDEO
- KEYBOARD, FLOPPY, MS MOUSE
- TOWER CASE 300 WATT

**\$5333**

## RAID 5 SOLUTIONS

REDUNDANT POWER SUPPLIES  
HOT SWAPPABLE DRIVES  
ALL SOLUTIONS UPGRADABLE

12GB	7200RPM	SCSI	\$6250
20GB	7200RPM	SCSI	\$8500
50GB	5400RPM	SCSI	\$28055
100GB	5400RPM	SCSI	\$39500

## STORAGE SOLUTIONS

			INT.	EXT.
9GB	SCSI		\$2000	\$2125
4GB	SCSI 7200RPM		\$1075	\$1175
4GB	SCSI-WIDE 7200RPM		\$1115	\$1240
2GB	SCSI 7200RPM		\$820	\$920
2GB	SCSI-WIDE 7200 RPM		\$854	\$980
96GB	4MM TAPE LIBRARY			\$4000

WE ONLY BUILD CUSTOM SOLUTIONS! CALL FOR PRICING.

# 1.800.989.3475

SAG ELECTRONICS • 451 ANDOVER STREET • NORTH ANDOVER, MA 01845 • 508-682-0055 • FAX 508-689-0180  
HOURS: 8:30AM-8:00PM, MONDAY-FRIDAY

GSA SCHEDULE PENDING

# SAG ELECTRONICS

AT&T on-site and 4 year extended warranties are available. Lease options available. Returns may be subject to restocking fee. RMA# must be acquired.

SAGBT7795



# Top 20 Technologies

20TH ANNIVERSARY REPORT

California garages again store cars and junk, not computer research labs as they did in the halcyon days of Woz and Jobs. Today, the myths may be tamer, but the pace of innovation hasn't changed. Here are the major technologies of the past 20 years.

## ■ Microkernel OSes

Proprietary OSes and closed hardware platforms were the reality when the goal was heterogeneous computing. Microkernel OSes burst these constraints with modern, modular OS cores that helped developers build applications faster and port software to a range of hosts without taking a performance hit. Programmers can build new functions into a system by mixing and matching code modules at run time. NextStep introduced these ideas to the commercial world with its Mach-kernel variation, which controlled memory and process management as well as interprocess communications. Carnegie Mellon University's Mach 3.0 now provides the underpinnings for IBM, the OSF, and Taligent's OS development. Microsoft's NT also borrows from the microkernel approach for smoother porting to Intel, Mips, and Alpha-based systems. Similarly, Apple's upcoming Copland release coalesces around a compact microkernel.

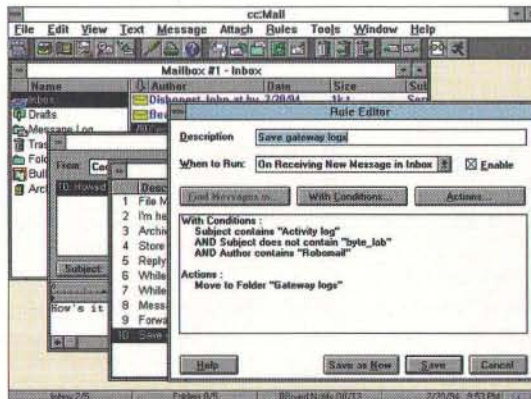
## ■ Structured Query Language (SQL)

How can telemarketers be sure they'll find your number the minute the dinner hour strikes? SQL is one essential tool, thanks to its ability to handle sets of data. SQL provided a way for interacting with relational databases, and it works with standard programming languages. For years, the burden for database manage-

ment fell on individual users, until 1969, when E. F. Codd, then at IBM, developed his relational theory of data, which addressed data structure, integrity, and manipulation. However, it wasn't until the mid-1970s that elements of his theories gained industry acceptance via SQL in Oracle and DB2.

## ■ Ethernet

We were so busy joking about when the Year of the LAN would finally come that we didn't realize when it had already happened. The key? Fast, easy-to-install Ethernet networks. Ethernet was visionary because it defined a network capable of 10-Mbps data rates before we needed that speed. Defined by Dr. Robert Metcalfe at Xerox PARC (Palo Alto Research Center), it took the combined efforts of Xerox, DEC, and Intel to turn Ethernet into a commercially viable standard. The version 1.0 specification arrived in September 1980. Two years later, version 2.0 addressed problems related to large networks, reliability, cost, and other issues. Changes to the specification included electrical signaling, cable types, connectors, packet formats, CSMA/CD and back-off algorithms, CRC (cyclic-redundancy check) calculation, and system timing.



YOU CAN BEND IT, SPINDLE IT, AND EVEN MUTILATE IT BY APPLYING RULES AND TRIGGERS. IT'S E-MAIL, THE EPISTOLARY TOOL FOR THE 1990S.



PEOPLE CAN'T MEMORIZE COMPUTER INDUSTRY ACRONYMS.



PLAIN BOX, FANCY PARALLEL ARCHITECTURE.



Top 20

# Technologies

## List #10 Predictions for the Year 2000

### On the "Killer App"

"A 'killer app' that takes over all of computerdom no longer exists, because computerdom is so big that even a large thing like the Web is still such a small piece...I think a killer application [today] is usually defined as something that takes a new configuration of hardware and makes it viable."

—Dan Bricklin, VisiCalc inventor

### On Mobile Computing

"Mobile wireless computers are like mobile pipeless bathrooms—portapotties. They will be common on vehicles, construction sites, and rock concerts. My advice is to wire up your home and stay there. Use information highways to let you stay home with your kids, not to make you more of a road warrior."

—Bob Metcalfe, inventor of Ethernet

### On Programming

"I've never been too good at predicting the future, but I can tell you what I wish would happen. I want software tools to become more literate and readable by people other than the programmer...I hope there will be a Pulitzer prize for the best writing of a computer program...There may be new tools to help nonprofessional programmers write programs, but programming is never going to be simple."

—Donald Knuth, TeX inventor

### On Voice Recognition

"I believe that voice recognition will become more important in the future but only for trivial functions. The problem is that spoken English is terribly imprecise, even when used by experts...I cannot imagine a more efficient interface for complicated tasks than a combination of mouse pointing and a standard keyboard."

—Thomas Kurtz, BASIC inventor

### On Wishful Thinking

Q: If you could get in the time machine and go back and change one thing that's happened in the history of computing, what would it be? A: "I would have written a BASIC interpreter for the first PCs."

—Bob Metcalfe, inventor of Ethernet

### On PDAs

In five years, PDAs will become a useful product because of the rapid increase in processing power, their ability to handle cross-platform data, and the communications infrastructure that will be in place.

—David Nagel, Apple

### On "Intelligent Agents"

"The computer as intelligent agent is not in our future; we haven't even achieved a Congress of intelligent agents after 200 years of trying. Instead, the computer for the twenty-first century will be the computer that stays out of your way, gets out of your desktop and into your clothing, connects you with people instead of with itself."

—Mark Weiser, Xerox PARC

### On Computer Interfaces

"The new things will be highly related to communication...Anthropomorphic-type appearances on-screen that are appealing, engaging."

—Bill Gates, Microsoft

"We'll continue to see some ill-fated attempts, like Microsoft's Bob and the Japanese Friend 2000 project, to animate the computer."

—Mark Weiser, Xerox PARC

"The PC operating systems are not going to be innovative ground for user interfaces. If you look at a lot of the CD-ROM products, they don't use the PC's user interface, they just make up their own. So maybe that's going to be some of the ground for the advances."

—Steven Jobs, Next

### On Schools

"I think we are going to expand a lot beginning with the schools that are more up on things, more the leaders. The keyboarding classes are going to [become...] classes that really teach about the guts of the computer...I think [we'll see] topics in schools teaching...how to use it...[and] how to get from one place to another."

—Steve Wozniak, inventor, lots of stuff

WEIRD ERROR  
MESSAGE NO.5

>SOMETHING BAD  
HAS HAPPENED  
WHICH HAS NO  
ERROR MESSAGE.  
PLEASE RESTART  
YOUR COMPUTER.

(from a kinder, gentler  
Windows)

Ethernet defined physical media and connections as well as how data, described as frames, is transferred across a LAN. (Very slight differences in how frames are defined separate the official IEEE 802.3 specification from the de facto Ethernet standard.)

### ■ Client/Server Networks

It's the tie that binds our desktop computers to the processing power, data, and resources of entire organizations. The architecture is the foundation for keeping a business running even if one component crashes. Client/server computing is also the means for technical democratization: We can choose the hardware and software that's best for us rather than declaring allegiances to a particular vendor. Without it, the mobile workers would remain a step behind office-bound comrades in having access to company resources; collaborative workgroups would still be defined by geographical proximity.

### ■ DSPs

What makes an application really sing? Lurking somewhere under the covers of audio, video, voice, and other multimedia applications are DSPs (digital signal processors). Modern versions of this venerable technology benefit from new chips and multitasking software that let DSPs simultaneously handle two or more processes.



WHERE DO YOU  
WANT TO GO

TODAY?™

→ Good question  
Microsoft.



# Top 20 Technologies

Evolving standards will make DSP application development easier, while general-purpose OSES, including Windows 95, are expected to include DSP programming interfaces, which could push DSPs further into traditional markets. In the future, digital hard drives will likely rely on DSP-powered drive controllers to process signals from the disk.

## ■ Floppy Disks

Like the proverbial 2-cent bolt that can ground a 767, how could we have worked without the lowly floppy disk? It has given us an inexpensive way to distribute applications and data. Floppies also gave uncon-

nected workgroups "sneakernets," inelegant but essential hacks in the pre-networked world. The Internet, WANs, and CD-ROMs may be cutting into the floppy's territory. And the world probably already has enough floppies in circulation—we just need to reformat all the disks stashed in desk drawers and file cabinets. But before you think floppies are obsolete, break the shrinkwrap on Microsoft's Office Professional 4.3: The collection of programs is still available on 31 disks.

## ■ Software Components

How do you implement custom applications quickly and not bust your operations budget? Plug in a component—those reusable, binary software objects that extend OSES by addressing specific needs. For Windows and the Mac, there are already OCXes (OLE controls); and components are also reshaping the various implementations of Unix and OS/2.

## ■ The Mouse

Like God and Man touching fingertips in Michelangelo's *Creation*, no other peripheral has done more to symbolically link computers with our humanness. Forget touch-typing or even hunt and peck; the mouse provided a way for computers to become accessible for millions of people. The original design dates back to the Stanford Research Institute and Douglas Engelbart's 1963 wooden prototype. In 1982, Mouse Systems introduced the first commercial mouse (a three-button design) for the IBM PC. The Apple mouse, originally for the Lisa, and Microsoft's mouse, with two buttons, came a year later. Today, the basic structure of interacting with our computers, whether Macintosh, Windows, or Unix, hinges on the mechanical or optical strains of this peripheral.

## ■ GUIs

The second component in humanizing how we interact with computers, modern GUIs

11  
YEARS  
AGO IN  
BYTE



A new Seiko wristwatch computer lets you enter data with a separate Hershey bar-size keyboard.

An unemployed security guard kills 20 people at a McDonald's in San Ysidro, California.

trace their roots to PARC (Palo Alto Research Center) research and the Xerox Star. GUI features introduced successfully in 1984 with Apple's Macintosh (e.g., windows, point-and-shoot menus, program and file icons, dialog boxes, and other now-familiar elements) let us manage our electronic desktops to suit our individual desires.

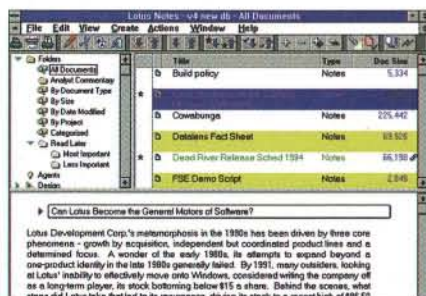
## ■ Hard Drives

The peripheral that taught us that too much is never enough. The fixed disk drive became a staple of microcomputers, thanks to its fast data access and transfer speeds. The technology never stood still. We're now getting gigabytes of storage space in petite form factors. In recent years, hard drives have increased data densities at an annual rate of about 60 percent. Magneto-resistive heads are leading the next charge by providing greater areal density than thin film or ferrite-inductive heads. Lower seek times, caching optimizations, and higher spin rates push performance even more. In the future, the digital read channel may double the amount of information we can jam onto drive platters.

## ■ Laser Printers

These fast, trusty machines have done more to impede the paperless office than any other peripheral. Once laser beams began to transfer images into toner on a

# Faster Faster ETHERNET, DISK DRIVES, MICROPROCESSORS, RAPID APPLICATION DEVELOPMENT



The mind of the corporation, the soul of reengineering: Groupware.



# But what about tomorrow?

Ask Windows users where they want to go today, and their answer is likely to be this: Windows 95. It is, after all, a major advance in the state of Windows



*While other PC manufacturers are still struggling to get CDs to load, Macintosh users can create their own multimedia, work in 3-D, surf the Internet and see what's real about virtual reality. Today.*

to Windows 95 really the right way to get there?

## The future of computing.

In a word, it's multimedia. Microsoft and Intel say it's the future. So do we. The difference is, we deliver that future today. To see what we mean, simply turn a Power Mac™ on. When you do, you can not only get down to work (or play) with the CD-ROM of your choice, you can also start using 3-D graphics. You can talk to your Mac™. And have it recognize your command. You can videoconference across continents. You can even dive into virtual reality.\* All at the touch of a few keys and the click of a mouse.

## The power to do it.

To do all this, you need power. And the best way to get it is with a Power Mac. In recent tests, for example, the RISC-based Power Macintosh™ 9500 outperformed a 120 MHz Pentium-processor-based



*Because Power Mac computers are based on the blistering fast PowerPC™ RISC chip, they have power to spare for tomorrow's advanced applications like interactive media and virtual reality.*

PC by 63% on average. When running scientific and technical apps, the performance advantage jumped to 80%. And for graphics, the Power Mac was more than twice as fast.\*\*



*Eleven years after it was first introduced, Macintosh is still the only personal computer in the world designed from the start as a seamless integration of hardware and software.*

## The easiest way to get there.

Of course, all the raw power in the world is worthless if you can't use it. That's why every new Mac includes an innovative help system that doesn't just answer your questions, but shows you what to do, where to click and what to type to get things done. And why we make it so easy to create Internet connections, install new software and set up entire new networks from scratch.



*The Power Macintosh 6100/66 DOS Compatible includes both a 66 MHz 486 chip and a RISC-based PowerPC chip, making it the most compatible computer you can find.*

## More choices than ever.

Today, every new Macintosh® can read and write DOS and Windows disks. But our compatibility goes further than that. The Power Macintosh 6100/66 DOS Compatible, for example, runs thousands of DOS and Windows applications, in addition to thousands of programs for Macintosh. And our new Power Mac systems accept standard PCI cards.

In the future, Apple innovations will further break down the barriers between cross-platform collaboration. Distinctions between the platforms themselves will diminish. Even the boundaries between applications will blur.

All of which will add up, once again, to the most important kind of power of all. The power to be your best.\*

To learn more about Macintosh power today, and tomorrow, visit us on the Internet today at <http://www.apple.com>.





# Top 20 Technologies

## List #11 20 Worst Acronyms

A survey reveals the alphabetic combinations BYTE readers dread most. By far the most disliked is PCMCIA.

### ATM

**Best guess:** High-speed communications technology, Adobe Type Manager, or cash dispenser

**Give up?** Asynchronous transfer mode

### BLOB

**Best guess:** Cheesy sci-fi monster

**Give up?** Binary large objects

### CORBA

**Best guess:** Rikki Tikki Tavi's serpentine nemesis, spelled sideways

**Give up?** Common Object Request Broker Architecture

### CSMA/CD

**Best guess:** Befuddlement

**Give up?** Carrier-sense multiple access/collision detection

### FAT

**Best guess:** Never mind the cheesecake

**Give up?** File allocation table

### FPSNW

**Best guess:** Notorious savings & loan that went bankrupt

**Give up?** File and Print Service for NetWare

### FTP

**Best guess:** Gasoline additive

**Give up?** File transfer protocol

### ISV

**Best guess:** Medical tubing

**Give up?** Independent software vendor

### MIME

**Best guess:** Street performer-induced desire to flee

**Give up?** Multipurpose Internet Mail Extensions

### OObE

**Best guess:** Fear that speaker is about to break into old Roy Orbison novelty tune (i.e., "Oobie Doobie")

**Give up?** Out-of-box experience

### PCMCIA

**Best guess:** People Can't Memorize Computer Industry Acronyms

**Give up?** Personal Computer Memory Card International Association, recently reduced to PC Card

### RISC

**Best guess:** Would they name a car The Liability?

**Give up?** Reduced-instruction-set computer

### SCSI

**Best guess:** The next big thing after grunge

**Give up?** Small computer system interface

### SOHO

**Best guess:** Favorite spot of werewolves of London

**Give up?** Small office/home office

### SQL

**Best guess:** Hollywood technique for capitalizing on success

**Give up?** Structured Query Language

### TCP/IP

**Best guess:** Oh you do, do you?

**Give up?** Transmission Control Protocol/Internet Protocol

### TWAIN

**Best guess:** Great American writer; things that shall never meet

**Give up?** Toolkit without an important name

### VESA

**Best guess:** Credit card; traveling papers

**Give up?** Video Electronics Standards Association

### WAIS

**Best guess:** Pronounced "ways"? "way-is"? "wah-is"?

**Give up?** Wide Area Information Servers

### WYSIWYG

**Best guess:** Harpo Marx's hairpiece

**Give up?** What you see is what you get

piece of paper, it became hard to resist producing hard-copy documents with as many fonts as we could lay our hands on. During the 1980s, high prices helped suppress our paper urge: 300-dpi laser printers sold for \$3000 and up, while 600-dpi lasers started at \$18,000 before going out of sight. Even so, the printers helped fuel new applications like desktop publishing. Now, 300 dpi is under \$1000.

### ■ LCDs

The feather weight, sleekness, and low power consumption of LCDs made mobile computing practical. As the technology advanced from the netherworld look of passive matrix to dual-scan and large-production-run active-matrix, we were able to travel with the same GUI-based applications we enjoyed on our desktop instead of packing stripped-down applications.

### ■ Software Agents

Finding data, organizing our schedules, teaching us to use new software applications, planning our vacations—software agents deliver what we've always wanted:

## Worst Repeat Offenders

"The acronyms in most CS, IT, and MIS want ads. I have a master's degree in CS and still can't read these ads."

—software engineer in Bozeman, MT

The telecomm and networking folks, who've given us such doozies as DFWMAC (distributed foundation wireless media access control), MESI (modified, exclusive, shared, invalid), and USART (universal synchronous/asynchronous receiver/transmitter)

Performance indicators, like SPECint92

World Wide Web addresses—  
<http://www.etc.etc.etc./better.not.make.a.typo>

The Really Stretching It Award goes to VERONICA (very easy rodent-oriented netwide index to computerized archives)





# Unleash your laptop.

**[ At last. Connectivity without the cord. ]**

Stop hunting for phone jacks! Make your laptop really portable with the Personal Messenger™ 100 Wireless Modem Card from Motorola. With this compact, easy-to-use card, you can send/receive E-mail from your office network or the Internet, send faxes, or access corporate databases, and more—free of phone lines. With the modem card and Motorola's AirMobile™ wireless software, laptop users with Lotus® cc:Mail™ Mobile for Windows® can directly access their corporate E-mail server to exchange messages and files over the ARDIS™ nationwide wireless data network. It's a single mailbox solution to support mobile workforces, traveling executives and others who want to keep in contact from just about anywhere.\* And, using the ARDIS network, there are no roaming or long-distance charges. To untether your laptop from phone lines forever, call for your nearest dealer and an information kit. And, for a limited time, take advantage of a special introductory rebate offer. Call our toll-free number for details.

**\$100 Motorola Rebate**  
on purchase of the  
Personal Messenger™ 100  
modem card.

**1-800-8-wireless**  
1 - 8 0 0 - 8 - 9 4 7 3 5 3

*No Wires. No Limits.™*



## Personal Messenger™ 100

Wireless Modem Card slips into most laptops, palmtops or PDAs with a Type II or III PCMCIA slot. This all-in-one peripheral features a built-in battery for stand alone operation, 8K message memory and fold-away antenna.

**Ideal for Lotus® cc:Mail™ Mobile users.**



\*The Personal Messenger™ modem card operates on the ARDIS nationwide, two-way wireless data network that covers over 90% of the U.S. business centers.™ and Motorola are registered trademarks and Personal Messenger is a trademark of Motorola, Inc. All other trademarks are the property of their respective owners. © 1995 Motorola, Inc. All rights reserved.

**Circle 229 on Inquiry Card.**



# Top 20

# Technologies

an electronic guardian angel. These small but smart programs travel into the world to interact, extract information, or deliver data and messages to other systems. The promise is to get work done or to react to fast changes in our business lives while we're off doing other things. However, security fears of these "good" viruses need resolution by the Safe-TCL (First Virtual Holdings) and Telescript (General Magic) developers of the world.

## ■ E-Mail

Jimmy Stewart in *The Philadelphia Story* called alcohol "the great leveler." The same could be said about E-mail. E-mail has become more than a mechanism for communication: It's given our ideas a forum for being presented to anyone in the organization, regardless of official chains of command. The Postal Service may go out of business.

## ■ Groupware

Work smarter. Collaborate. Meld the right people on a project-by-project basis. Break down the barriers among departments. Lotus Notes has been carrying this mantle since the late 1980s, and the payoff may be near, evidenced by the rising list of competitors. Groupware helps us tackle unstructured data in the form of text files, graphics, faxes, and E-mail that form the essence of our businesses. Once this data is organized into cohesive units, groupware helps us move the information throughout

organizations and provides a way for us to find it and pass it around quickly.

## ■ CD-ROMs

Turns out that the sum total of our business and cultural knowledge can be served up quite handily in 600-MB chunks. CD-ROMs have made video, audio, and text more accessible by letting us search for and randomly access information quickly and accurately. They have also become the medium of choice for companies needing to distribute proprietary information as well as service and training manuals.

## ■ PC Card (PCMCIA)

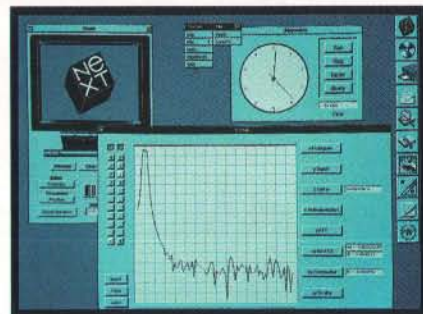
This technology survives in spite of itself. PC Card turns portables into customizable computing platforms that quickly connect to LANs, send and receive data files and faxes, and store information sensitive enough to require nighttime lock up. Developed by Neil Chandra for the Poquet computer, PC Card has grown to encompass much more than its original job as a memory card. However, diversity begat conflicts among cards, hardware platforms, OSeS, applications, and driver software. Card and Socket Services has helped smooth out incompatibilities, and the latest incarnations of PC Card include support for a 32-bit data path, bus mastering, and 3.3-V operation.

## ■ Visual Programming

Visual programming levels the elite and arcane aspects of programming to give tools for applications development, prototyping, and solving particular problems to a broader audience. HyperCard popularized the notion of visual prototyping and laid the groundwork for Visual Basic and Visual C++. Digitalk's Parts, PowerSoft's PowerBuilder, Oracle's PowerObjects, and Meta Software's Design/CPN are other descendants.

## ■ Parallel Processing

With the capability to perform a variety of operations simultaneously, parallel



WHERE WILL THE INNOVATIONS STOP? NEXT COMPUTER NOT ONLY MADE UNIX PALATABLE, IT BUILT A UNIX BASED ON THE MACH MICROKERNEL ARCHITECTURE. TOO BAD IT DIDN'T SELL.

processing gives new punch to database servers and the evolving computational servers. Shared-memory machines pool memory resources so that each CPU dips from the same pool. This limits scalability, but systems built on this model can run software intended for single-processor PCs. They also use standard CPUs and OSeS like NT and Unix. Message-passing systems retain private memory reserves and form the basis for massively parallel supercomputers. The result: superhigh performance for pennies.

## ■ Caching

New generations of CPUs grab the headlines, but MIPS alone won't make our applications run faster. By maximizing throughput from the CPU to system memory, memory caching helps memory chips keep pace with the needs of processors. Similarly, disk caching circumvents roadblocks between the CPU and slovenly hard and floppy drives by using a portion of system memory, in case chunks of data needed in the recent past are needed again. Slower CD-ROMs accrue similar performance benefits. Today, many types of CPUs have their own internal cache to squirrel away information important to the processor.





Aiuto  
 Segitseg  
 救命呀  
 Help  
 Hilfe  
 Ayuda  
 教えて  
 Aide  
 Towa Chuseyo

## When it comes to help for your computer, there's just one word you have to know.

CompuServe. Because on CompuServe you can be in direct touch with many of the hardware manufacturers and software publishers themselves. Not to mention a worldwide network of people like yourself who have already

encountered — and solved — the very same problems you have now. You'll get answers that are fast and accurate, so no problem will be a problem for long.

And that's just the tip of the iceberg. CompuServe is a vast, worldwide information resource that can help to make your life infinitely easier in many other ways, too. With everything from extensive global communications abilities to help keep you in touch, to vast research resources to help keep you in business — all at your service, 24 hours a day, seven days a week.

For more information on how much CompuServe can do for you, just call one of the phone numbers listed here or e-mail us at [USINFO@CIS.compuserve.com](mailto:USINFO@CIS.compuserve.com). And let us give you an example of just how helpful we can be.

COUNTRY	TOLL-FREE	DIRECT	FAX
Australia	1-800-025-240	(+61) (2) 410-4260	(+61) (2) 410-4223
Chile		(+56) (2) 696-8807	(+56) (2) 698-1474
France	AZUR: 36-63-81-22	(+33) 1-47-14-21-65	(+33) 1-47-14-21-51
Germany	0130 37 32	(+49) (+89) 66 53 5-111	(+49) (+89) 66 53 5-242
Hong Kong		(+852) 2599-2788	(+852) 2506-3445
Hungary		(+36) (1) 212-4612	(+36) (1) 212-3126
Israel		(+972) (3) 6388230	(+972) (3) 6388288
Japan		(+81) (3) 5471-5806	(+81) (3) 5471-5890
South Korea	080-022-7400	(+82) (2) 528-0472	(+82) (2) 528-0597
Mexico		(+52) (5) 629-8190	(+52) (5) 629-8198
New Zealand	0800-446-113	(+61) (2) 410-4260	(+61) (2) 410-4223
South Africa	0800-112252	(+27) (12) 841-2538	(+27) (12) 841-3604
Taiwan	080-251-009	(+886) (2) 651-6899	(+886) (2) 651-1801
United Kingdom	0800 289 378	(+44) (117) 976 0681	(+44) (117) 925 2210
Venezuela		(+58) (2) 793-2984	(+58) (2) 793-1952
Elsewhere		(+1) 614-529-1349	(+1) 614-529-1610





# ZEOS® Can Ship Today!

Ask us about  
**FREE Upgrades to  
Windows® 95!**

Tired of waiting and waiting for your new PC? Wait no more. With our special *Computers Now!*® program many of our award-winning and most popular packages can be shipped the same day you call.

## It's As Easy As:

- 1** Choose the ZEOS system package you want.  
(A sampling of what's available is shown.)
- 2** For same day shipping, call ZEOS at 800-554-5226 before 1 p.m. Central Time, Monday–Friday.
- 3** Upon credit approval, we'll ship your system *the same day you order!*\*



## Our Guarantee To You:

If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready.\*

## Need A Bigger Monitor?

We can upgrade your *Computers Now!* desktop or vertical system with a larger monitor—and still ship it the same day you order!\*

## Buy With Confidence

Not only are you getting a ZEOS PC fast, you're getting a fast PC. ZEOS has earned dozens of top industry awards for power and performance, besting the competitors time and time again. With an awesome price, ZEOS computers *are* your best value.

That's not all. ZEOS gives you the best support in the business—for an even better value. In fact, ZEOS has earned seven *PC Magazine* Readers' Choice for Service & Reliability awards. And ZEOS was the first to provide 24-hour toll-free technical support—365 days a year—for quick and accurate answers to all your technical questions.



To order your high-performance PC, call a ZEOS Systems Consultant today at 800-554-5226.



Pantera™  
486DX2-66  
**\$1695**  
Pentium™  
Processor  
75 MHz  
**\$1945**

### Package #2:

- 8MB RAM (Pentium processor includes EDO RAM)
- 850MB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- Diamond Stealth 64 PCI local bus graphics card with 1MB DRAM
- 15" SVGA color monitor
- 6-bay desktop case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Works Multimedia CD



Pantera™  
Pentium™  
Processors  
75 MHz  
**\$1995**  
90 MHz  
**\$2095**

### Discovery™ MM:

- 8MB EDO RAM
- 528MB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- Sound Blaster 16® stereo sound card and speakers
- 14,400 bps send/receive fax modem
- Diamond Stealth 64 PCI local bus graphics card with 1MB DRAM
- 15" SVGA color monitor
- 6-bay desktop case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Works Multimedia CD



Pantera™  
Pentium™  
Processor  
75 MHz  
**\$2145**

### Top Gun:

- 8MB EDO RAM, 256K synchronous SRAM cache
- 850MB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- 14,400 bps send/receive fax modem
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM
- 15" SVGA color monitor
- 6-bay desktop case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Works Multimedia CD

\*Orders must be for Computers Now! configurations; we've listed just a sampling here. Since we continuously update this list of configurations, please call to confirm your system is on the list. This offer is good only as long as these pre-built systems remain in stock. Monitor upgrades available as long as monitors remain in stock. Other ZEOS systems and configurations take slightly longer—about a week. Credit cards are subject to authorization. Orders must be received by 1 p.m. Central Time, M-F.

Purchase orders are subject to approval. Business leasing programs available. All prices, specifications and availability are subject to change without notice; call to confirm these and warranty details. Prices do not include shipping. All products and company names are trademarks or registered trademarks of their respective holders. Windows is a registered trademark of Microsoft Corporation in the U.S. and other countries. ZEOS is a registered trademark; Computers Now! is a registered servicemark; Z-Card is a servicemark; Amra, Pantera and Meridian trademarks of Micron Electronics, Inc. © 1995 MEL ZEOS, 1901 Industrial Blvd., Minneapolis, MN 55413 USA. Micron Electronics, Inc. is a publicly traded company (NASDAQ symbol: MUEI).

NOW2-BYT-9909





**Pantera™**  
486DX2-66  
**\$2095**

**Pentium™**  
Processor  
75 MHz  
**\$2345**  
90 MHz  
**\$2445**

### Package #3:

- 16MB RAM (Pentium processor includes EDO RAM)
- 1GB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- Diamond Stealth 64 PCI local bus graphics card with 1MB DRAM
- 15" SVGA color monitor
- 6-bay desktop case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Office Pro and Bookshelf CD



**Pantera™**  
**Pentium™**  
Processor  
90 MHz  
**\$2745**  
100 MHz  
**\$2895**  
120 MHz  
**\$3095**

### Hottest:

- 16MB EDO RAM, 256K synchronous SRAM cache
- 1GB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM
- 15" SVGA color monitor
- 10-bay vertical case (90 MHz, 100 MHz & 120 MHz)
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Office Pro and Bookshelf CD



**Pantera™**  
**Pentium™**  
Processor  
75 MHz  
**\$2595**  
90 MHz  
**\$2695**  
100 MHz  
**\$2845**

### Discovery Plus:

- 16MB EDO RAM, 256K synchronous SRAM cache
- 850MB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- Sound Blaster 16" stereo sound card, high-power speakers w/subwoofer
- 14,400 bps send/receive fax modem
- Diamond Stealth 64 PCI local bus graphics card with 1MB DRAM
- 15" SVGA color monitor
- 6-bay desktop case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Office Pro and Bookshelf CD



**Pantera™**  
**Pentium™**  
Processor  
75 MHz  
**\$2945**  
100 MHz  
**\$3195**  
133 MHz  
**\$3545**

### Best MM:

- 16MB EDO RAM, 256K synchronous SRAM cache
- 850MB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- Sound Blaster 16" stereo sound card and speakers
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Office Pro and Bookshelf CD



**Pantera™**  
**Pentium™**  
Processor  
100 MHz  
**\$3745**  
120 MHz  
**\$3945**  
133 MHz  
**\$4095**

### Best MM Supreme:

- 24MB EDO RAM, 256K synchronous SRAM cache
- 1.2GB local bus EIDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB floppy drive
- Sound Blaster 16" stereo sound card, high-power speakers w/ subwoofer
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Office Pro and Bookshelf CD



**Ambra™**  
486DX2-66  
**\$1345**

### Package #2:

- 8MB RAM, 256K SRAM cache
- 528MB hard drive
- 3.5" 1.44MB floppy drive
- On-board VESA local bus video
- 14" SVGA color monitor
- 4-bay desktop case
- MS-DOS 6.2, Windows for Workgroups, Microsoft Mouse
- MS Works



**Meridian™ 400C**  
DX4-100  
**\$2795**

### Package #3:

- 8MB RAM
- 350MB IDE hard drive
- External 3.5" 1.44MB floppy drive
- 14.4 PCMCIA fax/modem
- 79" dual-scan color VGA display
- Custom leather carrying case
- Extra battery
- MS-DOS 6.2, Windows for Workgroups
- MS Works
- 7.8" x 10.2" x 1.7"; 3.9 lbs.

**For active matrix display, add \$700**



**Meridian™ 800C**  
DX4-100  
**\$2995**

### Package #3:

- 8MB RAM
- 528MB IDE hard drive
- Internal 3.5" 1.44MB floppy drive
- 14.4 PCMCIA fax/modem
- 10.3" dual-scan color VGA display
- Custom nylon carrying case
- Extra battery
- MS-DOS 6.2, Windows for Workgroups
- MS Works
- 8.9" x 11.7" x 1.9"; 6.3 lbs.

**For active matrix display, add \$800**



**Meridian™ 850C**  
**Pentium™**  
Processor  
75 MHz  
**\$4195**

### Package #3:

- 16MB RAM, 256K synchronous SRAM cache
- 1.3GB IDE hard drive
- Internal 3.5" 1.44MB floppy drive
- Integrated 16-bit stereo sound
- External amplified speakers
- 10.3" dual-scan color 800 x 600 SVGA display
- Custom nylon carrying case
- Extra battery
- MS-DOS 6.2, Windows for Workgroups
- MS Office Pro
- 8.9" x 11.7" x 2.1"; 6.8 lbs.

**For active matrix display, add \$800**

Fax Orders: 800-362-1205 or 612-362-1205. Phone Orders: Outside U.S. and Canada: 612-362-1212, Government: 800-245-2449, ZEOS Information Systems, Inc. GSA #GS00K94AGS5176. Purchase Orders, MasterCard, VISA, Am Ex, Discover, Z-Card, COD and leasing programs.

**800-554-5226**  
24 Hours a Day • 365 Days a Year

**ZEOS**

Circle 255 on Inquiry Card.



# VOYAGER 64

64-BIT **LIGHTNING-FAST** GRAPHICS ACCELERATOR

**GRAPHICS  
COME  
TO LIFE**

Watch graphics  
jump off the  
screen with  
the stunning  
Voyager 64  
Graphics Accelerator  
from Boca Research

Coming soon to a PC near you  
**The Voyager Movie Player!**

## Turbo-charged graphics for Windows™ 95.

With blazing speed and razor sharp imaging, the Voyager 64's stunning performance is driven by a true 64-bit graphics engine based on the industry-leading S3 Trio64™ architecture.

From CAD and animation...  
to cutting-edge  
games and 3-D  
applications...the  
Voyager 64 empowers PCs  
to attain new levels of graphic  
performance. And it supports resolutions of  
up to 1600 x 1200, with color depths up to  
16 million colors at 800 x 600 resolution.



The Plug and Play PCI Bus interface optimizes graphic performance even under heavy system loads and easy-to-install drivers are included to support all popular GUI applications.

The Voyager 64 boasts a dazzling array of features, including Windows 95 compatibility; made in the USA; a five-year limited warranty; free technical support and 24-hour bulletin board service.

**Competitively priced, call  
your favorite Boca Research  
supplier today!**



**BOCA**  
RESEARCH INC

(407) 997-6227 • FAX (407) 997-0918  
1377 Clint Moore Road • Boca Raton, FL 33487-2722



# A Brief History of Programming Languages

We've come a long way from computers programmed with wires and punch cards. Maybe not as far as some would like, though. Here are the innovations in programming.

## ca. 1946

**Konrad Zuse**, a German engineer working alone while hiding out in the Bavarian Alps, develops Plankalkül. He applies the language to, among other things, chess.

## 1949

**Short Code**, the first computer language actually used on an electronic computing device, appears. It is, however, a "hand-compiled" language.

## 1951

**Grace Hopper**, working for Remington Rand, begins design work on the first widely known compiler, named A-0. When the language is released by Rand in 1957, it is called MATH-MATIC.

## 1952

**Alick E. Glennie**, in his spare time at the University of Manchester, devises a programming system called AUTOCODE, a rudimentary compiler.

## 1957

**FORTRAN**—mathematical FORMula TRANslating system—appears. Heading the team is John Backus, who goes on to contribute to the development of ALGOL and the well-known syntax-specification system known as BNF.

## 1958

**FORTRAN II** appears, able to handle subroutines and links to assembly language. **John McCarthy** at M.I.T. begins work on LISP—LISt Processing. **The original specification for ALGOL** appears. The specification does not describe how data will be input or output; that is left to the individual implementations.

## 1959

**LISP 1.5** appears. **COBOL** is created by the Conference on Data Systems and Languages (CODASYL).

## 1960

**ALGOL 60**, the first block-structured language, appears. This is the root of the family tree that will ultimately produce the likes of Pascal. ALGOL goes on to become the most popular language in Europe in the mid- to late-1960s.

**Sometime in the early 1960s**, Kenneth Iverson begins work on the language that will become APL—A Programming Language. It uses a specialized character set that, for proper use, requires APL-compatible I/O devices.

## 1962

**APL** is documented in Iverson's book, *A Programming Language*. **FORTRAN IV** appears. **Work begins** on the sure-fire winner of the "clever acronym" award, SNOBOL—StriNg-Oriented Symbolic Language. It will spawn other clever acronyms: FASBOL, a SNOBOL compiler (in 1971), and SPITBOL—SPeedy Implemen-

tation of snoBOL—also in 1971.

## 1963

**ALGOL 60** is revised. **Work begins on PL/I**.

## 1964

**APL360** is implemented.

**At Dartmouth University**, professors John G. Kemeny and Thomas E. Kurtz invent BASIC. The first implementation is a compiler. The first BASIC program runs at about 4:00 a.m. on May 1, 1964.

**PL/I** is released.

## 1965

**SNOBOL3** appears.

## 1966

**FORTRAN 66** appears. **LISP 2** appears. **Work begins on LOGO** at Bolt, Beranek, & Newman. The team is headed by Wally Fuerzeig and includes Seymour Papert. LOGO is best known for its "turtle graphics."

## 1967

**SNOBOL4**, a much-enhanced SNOBOL, appears.

## 1968

**ALGOL 68**, a monster compared to ALGOL 60, appears. Some members of the specifications committee—including C.A.R. Hoare and Niklaus Wirth—

protest its approval.

**ALGOL 68** proves difficult to implement. **ALTRAN**, a FORTRAN variant, appears. **COBOL** is officially defined by ANSI. **Niklaus Wirth** begins work on Pascal.

## 1969

**500 people** attend an APL conference at IBM's headquarters in Armonk, New York. The demands for APL's distribution are so great that the event is later referred to as "The March on Armonk."

## 1970

**Sometime in the early 1970s**, Charles Moore writes the first significant programs in his new language, Forth. **Work on Prolog** begins about this time. **Also sometime in the**

**early 1970s**, work on Smalltalk begins at Xerox PARC, led by Alan Kay. Early versions will include Smalltalk-72, Smalltalk-74, and Smalltalk-76.

**An implementation of Pascal** appears on a CDC 6000-series computer.

**Icon**, a descendant of SNOBOL4, appears.

## 1972

**The manuscript** for Konrad Zuse's Plankalkül (see 1946) is finally published. **Dennis Ritchie** produces C. The definitive reference manual for it will not appear until 1974.

**The first implementation of Prolog**—by Alain Colmerauer and Phillip Roussel—appears.



"IT'S BETTER TO ASK FORGIVENESS THAN IT IS TO GET PERMISSION."—THE LATE REAR ADMIRAL GRACE HOPPER, WHO LED THE EFFORT TO CREATE COBOL



# A Brief History of Programming Languages

**13**  
YEARS  
AGO IN  
**BYTE**



Imagine a \$500 PC that has a built-in modem, fits in your pocket, and is battery powered.

Two British explorers reach the North Pole by way of the South Pole.

**1974**

Another ANSI specification for COBOL appears.

**1975**

**Tiny BASIC** by Bob Albrecht and Dennis Allison (implementation by Dick Whipple and John Arnold) runs on a microcomputer in 2 KB of RAM. A 4-KB machine is sizable, which left 2 KB available for the program. **Bill Gates and Paul Allen** write a version of BASIC that they sell to MITS (Micro Instrumentation and Telemetry Systems) on a per-copy royalty basis. MITS is producing the Altair, an 8080-based microcomputer. **Scheme**, a LISP dialect by G.L. Steele and G.J. Sussman, appears. **Pascal User Manual and Report**, by Jensen and Wirth, is published. Still considered by many to be the definitive reference on Pascal. **B.W. Kerninghan** describes RATFOR—RATional FORTRAN. It is a preprocessor that allows C-like control structures in

FORTRAN. RATFOR is used in Kernighan and Plauger's "Software Tools," which appears in 1976.

**1976**

**Design System Language**, considered to be a forerunner of PostScript, appears.

**1977**

**The ANSI standard for MUMPS**—Massachusetts General Hospital Utility Multi-Programming System—appears. Used originally to handle medical records, MUMPS recognizes only a string data-type. Later renamed **M**. **The design competition that will produce Ada** begins. Honeywell Bull's team, led by Jean Ichbiah, will win the competition. **Kim Harris** and others set up FIG, the FORTH interest group. They develop FIG-FORTH, which they sell for around \$20. **Sometime in the late 1970s**, Kenneth Bowles produces UCSD Pascal, which makes Pascal available on PDP-11 and Z80-based computers.

**Niklaus Wirth** begins work on Modula, forerunner of Modula-2 and successor to Pascal.

**1978**

**AWK**—a text-processing language named after the designers, Aho, Weinberger, and Kernighan—appears. **The ANSI standard for FORTRAN 77** appears.

**1980**

**Smalltalk-80** appears. **Modula-2** appears. **Franz LISP** appears. **Bjarne Stroustrup** develops a set of languages—collectively referred to as "C With Classes"—that serve as the breeding ground for C++.

**1981**

**Effort** begins on a common dialect of LISP, referred to as Common LISP. **Japan** begins the Fifth Generation Computer System project. The primary language is Prolog.

**1982**

**ISO Pascal** appears. **PostScript** appears.

**1983**

**Smalltalk-80: The Language and Its Implementation** by Goldberg et al is published.

**Ada** appears. Its name comes from Lady Augusta Ada Byron, Countess of Lovelace and daughter of the English poet Byron. She has been called the first computer programmer be-

cause of her work on Charles Babbage's analytical engine. In 1983, the Department of Defense directs that all new "mission-critical" applications be written in Ada.

**In late 1983 and early 1984**, Microsoft and Digital Research both release the first C compilers for microcomputers.

**In July**, the first implementation of C++ appears. The name is coined by Rick Mascitti.

**In November**, Borland's Turbo Pascal hits the scene like a nuclear blast, thanks to an advertisement in BYTE magazine.

**1984**

**A reference manual for APL2** appears. APL2 is an extension of APL that permits nested arrays.

**1985**

**Forth** controls the submersible sled that locates the wreck of the Titanic. **Vanilla SNOBOL4** for microcomputers is released. **Methods**, a line-oriented Smalltalk for PCs, is introduced.

**1986**

**Smalltalk/V** appears—the first widely available version of Smalltalk for microcomputers. **Apple** releases **Object Pascal** for the Mac. **Borland** releases Turbo Prolog.

**Charles Duff** releases Actor, an object-oriented language for developing Microsoft Windows applications. **Eiffel**, another object-oriented language, appears. C++ appears.

**1987**

**Turbo Pascal** version 4.0 is released.

**1988**

**The specification for CLOS**—Common LISP Object System—is published.

**Niklaus Wirth** finishes Oberon, his follow-up to Modula-2.

**1989**

**The ANSI C** specification is published. C++ 2.0 arrives in the form of a draft reference manual. The 2.0 version adds features such as multiple inheritance and pointers to members.

**1990**

C++ 2.1, detailed in *Annotated C++ Reference Manual* by B. Stroustrup et al, is published. This adds templates and exception-handling features.

**FORTRAN 90** includes such new elements as case statements and derived types.

**Kenneth Iverson** and Roger Hui present J at the APL90 conference.

**1991**

**Visual Basic** wins BYTE's Best of Show award at Spring COMDEX.

**1992**

**Dylan**—named for Dylan Thomas—an object-oriented language resembling Scheme, is released by Apple.

**1993**

**ANSI releases the X3J4.1 technical report**—the first-draft proposal for (*gulf*) object-oriented COBOL. The standard is expected to be finalized in 1997.

**1994**

**Microsoft** incorporates Visual Basic for Applications into Excel.

**1995**

**In February**, ISO accepts the 1995 revision of the Ada language. Called Ada 95, it includes OOP features and support for real-time systems.

**1996**

Anticipated release of first ANSI C++ standard.

**WEIRD ERROR MESSAGE NO. 7**

>THIS STYLE OF CODE IS NO LONGER USED.

(fashion news from Borland C++)



# Watcom C/C++

## Increase Your Competitive Advantage with New Version of Award-Winning Development System

**New!**  
Version 10.5  
Now with Windows<sup>®</sup>95 Support  
& Visual Programmer by Blue Sky Software

Watcom C/C++ increases your competitive advantage in the development of high-performance, multi-platform 16 and 32 bit applications. The integrated development environment simplifies application development and makes it easy to exploit the power of Watcom C/C++. In a single package, Watcom C/C++ provides a comprehensive development environment with the tools, SDKs and libraries you need to create powerful 16 and 32 bit applications for popular PC platforms.

### Leverage Your Time and Code Investment

Watcom C/C++ supports a wide range of host and target platforms including Windows<sup>®</sup>95\*. Reliable, high-performance code generation and consistent C and C++ language implementation are delivered across all supported platforms, making it easy to develop applications for several targets from a single source code base. For example, C++ templates and exception handling are provided on all supported platforms including 16-bit Windows.

**Host Platforms:** Windows 95, Windows NT, Windows 3.x, OS/2 Warp, OS/2 2.x, DOS

**Target Platforms:** Windows 95, Windows NT, Windows 3.x, Win32s, OS/2 Warp, OS/2 2.x, Extended DOS, Novell NLM, OS/2 1.x, DOS

### Accelerate Your Windows Development

For rapid 16 and 32 bit Windows development, Watcom C/C++ includes the Microsoft Foundation Class (MFC) libraries and Visual Programmer (VP) by Blue Sky Software. VP is a fast MFC code generator for quick, easy and intuitive development of Windows applications. With VP, application user interfaces are designed visually using point-and-click interaction. Functional preview mode allows for quick testing of the user interface.

### High Performance

Watcom's advanced compiler technology generates fast, tight code, optimizing your application's performance. Superscalar optimization strategy uses "riscification" and instruction scheduling to deliver optimum performance on 486 and Pentium processors.

Watcom C/C++ 10.5. Isn't it time you increased your competitive advantage?

**Call Watcom NOW on +44 1494 555599  
or fax +44 1494 555595**

**Limited Time Competitive Advantage Offer:  
Watcom C/C++ v10.5 CD-ROM Edition.....\$199**

Watcom C/C++ v10.5 CD-ROM Edition.....\$350  
(All prices quoted in US dollars and exclude tax and shipping.)



April 11, 1995  
Watcom C/C++ 10.0

**Watcom**  
A Powersoft Company

Watcom Europe Ltd. Kingsmead Business Park, High Wycombe, Bucks, UK. Phone +44 1494 555599. Fax +44 1494 555595.  
Watcom International Corp. 415 Phillip Street, Waterloo, Ontario, Canada N2L 3X2. Phone (519) 886-3700. Fax (519) 747-4971.

Watcom and the Lightning Device are trademarks of Watcom International Corp. Windows is a registered trademark of Microsoft in the U.S. and other countries. BLUE SKY SOFTWARE and VISUAL PROGRAMMER are trademarks or registered trademarks owned by Blue Sky Software Corporation. Other trademarks are the properties of their respective owners. ©Copyright 1995 Watcom International Corp.

\*Get started with Windows 95 development using Watcom C/C++ and the pre-release version of Windows 95. All registered Watcom C/C++ 10.5 developers are entitled to receive a free version 10.6 upgrade, after Windows 95 is released.

**Circle 254 on Inquiry Card**



# OVER FORTY MEGABYTES OF WINDOWS 95 WILL SOON LUMBER INTO YOUR HARD DISK.

## MAKE ROOM.

You can spend \$2,995 and buy a new computer with a humongous hard disk. Or you can spend \$29.95 and clean up the one you have. Rid it surgically and safely of unwanted or duplicate files and programs. Quarterdeck CleanSweep™ will work with Windows 3.1 and Windows 95 to find all the megs you want and more in a jiffy. Call (800) 354-3222 or your nearest retailer and brace yourself.

©1995 Quarterdeck Corporation. Quarterdeck is a registered trademark. CleanSweep is a trademark of Quarterdeck Corporation. All other trademarks are properties of their respective owners.



# Notorious Bugs

Bugs in computer hardware and software are no more than the crystallization in silicon and plastic of the mental mistakes all people make. People are only human, after all, so computers can only reflect our own humanity.

## ■ The Bug That Never Was, Thank Heaven

1983: The SDI (Strategic Defense Initiative) proposal was intended to defend the U.S. against a nuclear missile attack by using computer-aimed weapons to shoot down the missiles. It was estimated that the software would have required some 10 million to 100 million lines of code. Without the Soviet Union's cooperation in staging nuclear missile attacks to test it, the system would have to work perfectly—bug-free—the first time it was ever used. Despite widespread misgivings, a 1986 Department of Defense panel concluded that the concept was still feasible.

## ■ Check Box to Prepay

1985: An IRS computer error resulted in 27,000 companies receiving warning notices to pay employee federal withholding taxes that they had, in fact, already paid. The House and the Senate planned hearings to investigate.

## ■ The Bug That Killed

1985–1987: At least four people died when they were exposed to lethal doses of radiation from Therac-25 linear accelerator machines (made by Atomic Energy of Canada Ltd.), used for radiation treatment of cancer. Software errors caused the machines to incorrectly cal-

culate the amount of radiation being delivered to the patient. The most tragic incident to date of death or injuries to human beings due to defective computer software, this incident is a reminder that, as we entrust human lives and health to computers, the seriousness of eliminating bugs becomes a life-or-death proposition.

## ■ A Bug in a Worm in a Net

1988: A math error caused a “worm” program to multiply 14 times faster than intended, and as a result, the Internet was swamped and overwhelmed in a few hours. It was weeks before affected systems recovered from the damage wrought, costing in the hundreds of millions of dollars. Robert T. Morris, Jr., the Cornell University graduate student who wrote and unleashed the worm, later said, “It was a mistake. I’m sorry.”

## ■ Computer's Down, Check Your Pitons

1988: Backup data, corrupted due to software errors, eventually destroyed all the main system data—and backup copies of data—at an automated Black & Decker distribution center in Northampton, England. Employees were eventually forced to climb the racks of inventory in the unlit warehouse with mountain-climbing equipment to check stock.

## ■ To Whom It May Concern...

1989: A computer in Paris read files on traffic violations and then mistakenly sent out letters charging 41,000 traffic offenders with crimes including murder, drug trafficking, extortion, and prostitution. Recipients were described as “surprised.”

## ■ Why Doesn't This Ever Happen at Our Bank?

1989: A British bank that understandably wishes to remain nameless mistakenly transferred an extra £2 billion to customers in only 1 hour, when a bug permitted payment orders to be issued twice. Since there was no way to distinguish real from duplicate transactions, the bank had to depend on the honesty of its customers to recover the extra payments.



# Notorious Bugs

## ■ Dial B for Bug

1990: A logic error in its call-handling computers shut down AT&T's long-distance telephone network for 9 hours, the most severe breakdown in the history of the U.S. telephone system. Some 74 million long-distance and 800-number calls were not completed, bringing phone-dependent businesses—like car, hotel, and airline reservations systems, and credit-card approval services—to a standstill.

## ■ Sin of Omission

1991: American Patriot missiles were fairly successful. However, the failure of some Patriot missiles to track and destroy Iraqi Scud missiles during the Persian Gulf War may have been due to a software problem of the system. During one such Iraqi missile attack, 28 American soldiers were killed in their barracks in Dhahran, Saudi Arabia.

## ■ A Better Windows than DOS

1991: With the introduction of Microsoft Windows 3.0, "unrecoverable application error" became a household phrase, soon to be replaced by "general protection fault" in version 3.1 (heralded by the headline "Windows Upgrade Crashes Less Often").

## ■ Don't Use the Calculator! We Need the Right Answer!

1991: It was revealed in 1994 that the Calculator applet in Microsoft Windows did not display correct answers. Reportedly, it took the Pentium bug brouhaha to motivate Microsoft to admit and fix a bug it may have known about since 1991.

## ■ You Are Lost and Gone Forever...

1993: An \$80 million satellite called Clementine was hopelessly lost in space after a software error caused its thruster rockets to fire continually, consuming all its fuel before its asteroid-rendezvous mission was completed.

## ■ Double, Double, Toil and Trouble

1993: The DoubleSpace automatic hard disk compression software included in Microsoft MS-DOS 6.0—billed as capable of nearly doubling the effective space on hard drives—corrupted data, was incompatible with certain BIOSes, and crashed programs and networks. Besides which, Microsoft lost a compression patent-infringement suit brought by Stac Electronics, to the tune of over \$100 million. (Of course, it later struck a partnership with Stac.) Version 6.2, which cleared up the majority of these problems, was denied to be a "bug fix."

## ■ Don't Even Leave the Airport

1994: For months, bugs in a computerized baggage-handling system delayed the opening of the new Denver airport. The system would drive automated baggage carts into walls or deposit bags at the wrong airport destination. After an additional expenditure of some \$80 million to fix the system, the airport finally opened in February 1995—with a manual baggage-handling system that will be phased out gradually. Sometimes you just can't beat the human touch.

## ■ Dividing We Fall

1994: The Pentium bug, probably the most widely reported-on bug in history, was a glitch in the lookup table used to perform floating-point division in Intel's flagship chip. The magnitude of errors ranged from 1 out of 10,000 to 1 out of 1 quadrillion, while estimates of the frequency of errors varied widely from days to millennia. Probably more significant than the defect itself was the fact that Intel's reputation was tarnished needlessly: Intel knew about the problem, decided to keep it a secret, and then downplayed the defect when it was discovered independently. It is estimated that Intel may have lost upward of \$400 million due to the Pentium bug.

8  
YEARS  
AGO IN  
**BYTE**



Steve Ciarcia builds the ultimate infrared remote control device: It controls all your other remotes.

U.S. Surgeon General C. Everett Koop recommends televised condom commercials to fight AIDS.

## ■ Oh, I Just Can't Wait to Be (Wor)king

1994: Disney Interactive was the cause of some Christmas-morning traumas when its Lion King animated story CD-ROM, easily the most-anticipated and best-selling title during that season, wouldn't work. Inadequate testing by third-party developers caused installation failures on many PC systems. This may have been the first bug to affect popular culture.

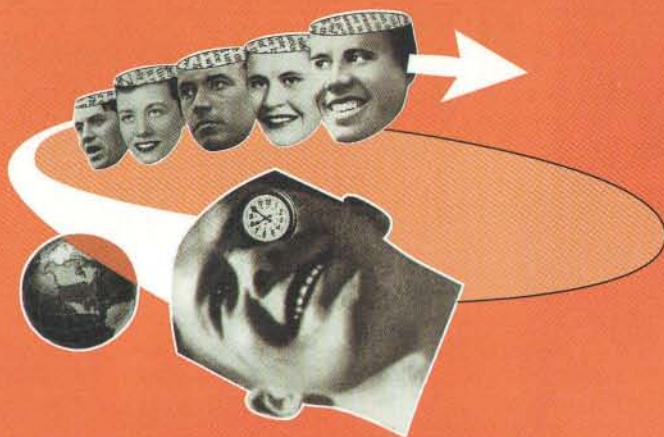
## ■ And on Wall Street, 166 Funds Remain Unchanged

1994: One day, Fidelity Investments, the \$250 billion mutual fund corporation, was temporarily unable to calculate the "net asset value" for 166 of its 208 mutual funds because a bug had overwritten every stock in its database with 9s. A low-level employee authorized using the closing prices of the previous day rather than admitting that Fidelity didn't know what the actual prices were. The subsequent uproar resulted in the establishment of rules for handling such situations in the future.

## ■ The Incredible Growing File

1994: A bug in CorelDraw 5 caused the size of a file to multiply wildly when certain operations were performed, transforming 2-MB files into 30-MB behemoths. Although fixed in subsequent releases, another file size problem later emerged.





# TAKE INFORMATION

FROM THE MINDS OF THE FEW

AND PUT IT INTO THE  
MINDS  
OF THE MASSES.

**CD-ROM changed the way you think about computers. And the AXIS Network CD-ROM Server is going to change the way you think about CD-ROM.**

(Pretty bold statement there, but if you're dealing with a network, please read on.) These breakthrough servers hook into your network and allow your users to share information. And each one can handle up to seven drives at any one time.



These RISC-based, multiprotocol servers make network integration trouble-free. (In other words, they support SMB over NetBEUI/NetBIOS, and NFS over TCP/IP, allow Windows and UNIX users to share information, don't need software drivers or file servers, and install anywhere.)

For further information, please call one of our local distributors. Because when it comes to information, sharing the wealth can be a capital idea.

**AXIS**  
COMMUNICATIONS

Germany: 064 04 9105-0

UK: 0483-797787

France: (1) 69 07 66 71, (1) 40 10 28 28, (1) 60 13 13 14

e-mail: [info@axis.se](mailto:info@axis.se)

URL: <http://www.axis.se>



# Notorious Bugs

## ■ Three of Life's Certainties: Death, Taxes—and Bugs

1994–1995: Intuit announced that calculation errors or loss of data could occur in both its TurboTax and MacInTax income tax preparation programs. Many people use such programs because they are worried about making errors by doing their taxes manually. Can you say “irony”?

## ■ Absolutely, Positively Deleted

1995: Millions of Super Bowl telecast watchers were impressed by ads for Federal Express's new Windows software for handling package pickup and keeping track of FedEx deliveries. Unfortunately for the estimated 15,000 companies that started using the first release, all their records were deleted on the first day of each month.

## ■ The Bug Is Yet to Be

2000: When the global odometer turns over on January 1, 2000 A.D., computer systems the world over are expected to buckle. Legacy mainframe programs hard-coded to treat the year “00” as 1900 will begin calculating negative ages, seniorities, and benefits. Where will your bet be when the millennial roulette wheel comes up “00”?

## List #14 Best Computer Shows

Of late, it seems many trade shows are more about chachkis than products or technologies. But that wasn't always the way...

### The Faire Queen

The West Coast Computer Faire earns top honors from those who remember it. One year, it filled (and we mean *filled*) Brooks Convention Center in San Francisco, with booths in the halls and in the chair storage room—and even in the garbage collection area! It was where the first 68000 was shown, where the Lilith was shown, and where little computers got seen by a lot of people who had never paid any attention to them before. So what if its name is spelled funny?

### CD Chance

Bill Gates isn't just the head of the largest software company in the world—he's also the father of the CD-ROM Conference. At the time, it seemed a financial risk for him (the richest man in the world), but looking back, it was clearly right.

### On the First Comdex

It was a small show. Contributing editor Jerry Pournelle went to it because he could drive to it. He says, “Wasn't much, but it sure kicked things off.” By the third Comdex, things were really happening. Now it cripples Las Vegas every fall.

### Wescon

Trolley cars, the Golden Gate Bridge, and fog aren't the only things to come out of San Francisco. In the mid-1970s, it was also the place to hear about the latest chips. Among other things, the MOS Technology 6502 (to become the brains of Steve Wozniak's Apple II) was introduced there.

### Tell All

The microprocessor field is highly competitive and very secretive. The Microprocessor Forum is a kind of you-show-me-yours-and-I'll-show-you-mine show. If you keep your ears and eyes open, you'll see what every major processor company is planning for the next three to five years. Well, maybe not everything.

CD-ROM  
EXPO

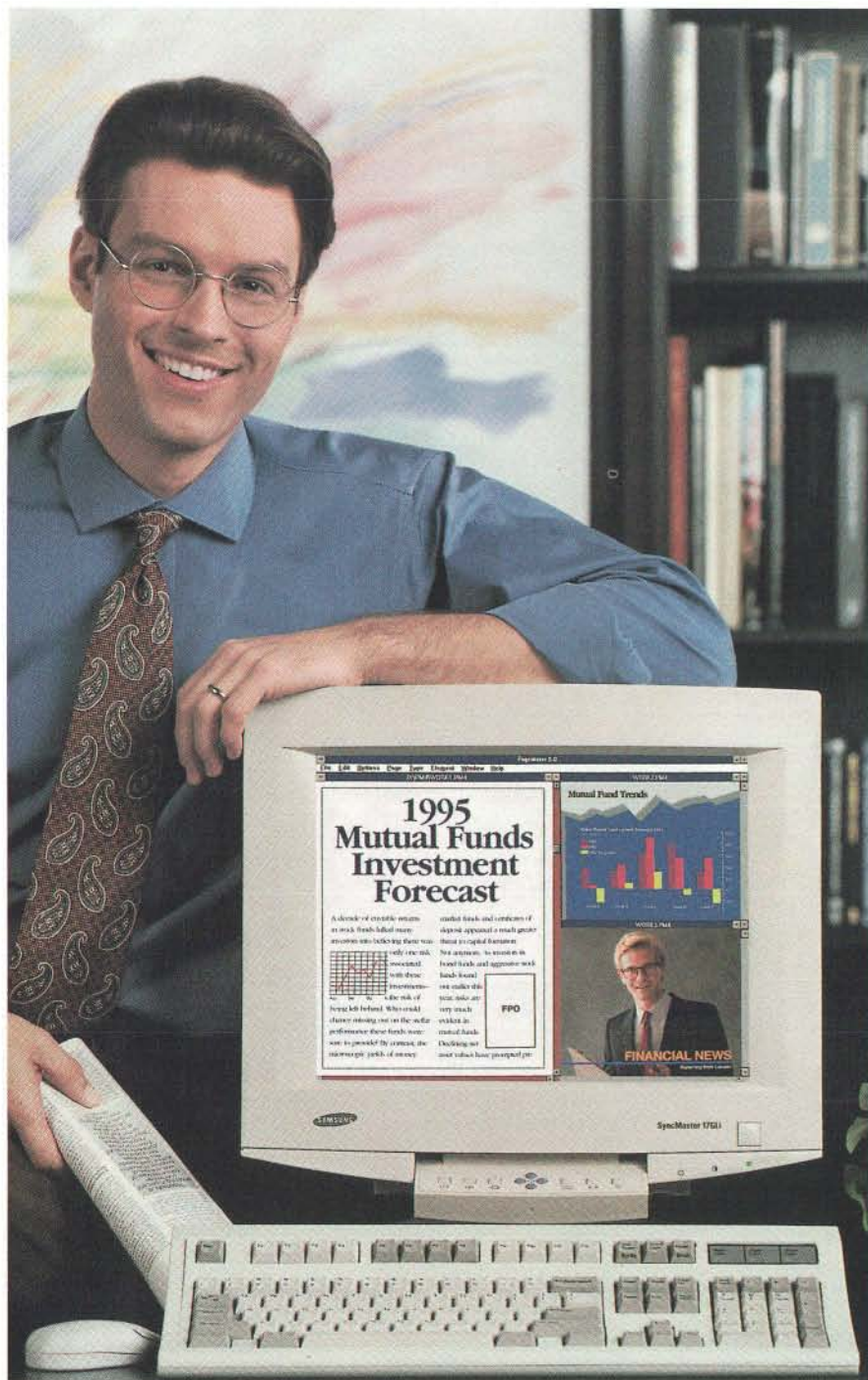
COMDEX/Fall'95



Wescon/95



# Samsung monitors. Designed from your point of view.



## SyncMaster™ 17GLi.

Today's applications demand more from your monitor. That's why Samsung created the GLi Series monitors. They work the way you do.

**Performance** is only part of the reason to buy a new 17-inch SyncMaster monitor. It has big, bright, crisp, clear images that you can depend on year after year.

**Simplicity** is also important. The GLi Series offers Plug and Play\* compatibility, so you can get right to work. Its intuitive controls and on-screen programming keep concentration where it belongs – on the job.

Plus, Samsung delivers outstanding **Value** – in the comfort of a three-year warranty, and the satisfaction of a competitive price.

If you take your work seriously, think about an exceptional monitor. Think about the SyncMaster 17GLi. After all, it's your point of view.

Call 1-800-933-4110 or use fax-on-demand at 1-800-229-2239 for more information.

SyncMaster	15GLi	17GLi	17GLsi
Flat Square CRT	15"	17"	17"
Dot Pitch	.28	.28	.26
PC Compatibility	1280x1024@60Hz	1280x1024@60Hz	1280x1024@80Hz
Mac Compatibility	1024x768@75Hz	1024x768@75Hz	1152x870@75Hz
Color Temp. Selection	•	•	•
UltraClear Coating™	•	•	•
Limited Warranty	3 Years	3 Years	3 Years

Actual viewable areas are 14.0" (15GLi) and 16.0" (17GLi and 17GLsi).



© 1995 Samsung Electronics America, Inc. SyncMaster™ and UltraClear Coating™ are trademarks of Samsung Electronics. \*When used with Windows 95™ is a Plug and Play operating system conforming to VESA guidelines. Use of the Energy Star logo is not considered to be a product endorsement.

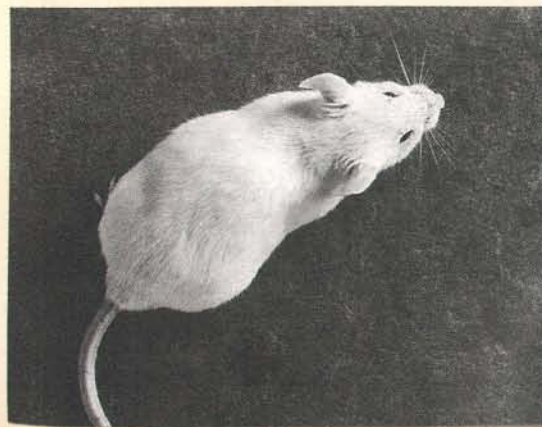
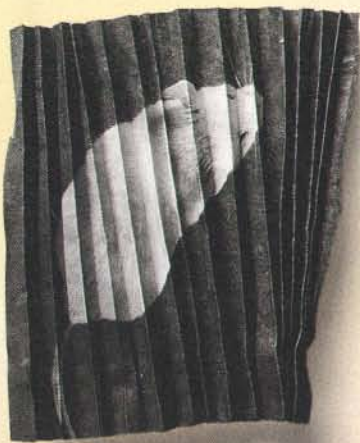


Circle 274 on Inquiry Card.




# Laboratory tests prove you'd rather have our paper path.

Think what it's like inside a scanner. Heat, noise, gears, belts, rollers. No wonder so many little pieces of paper get mangled. No wonder users spend so much time trying to pull tiny shreds out of the rollers with their bare hands. That's why we design our scanners with the simplest, most straightforward paper path in the industry. So they can handle any kind of document.



From onionskin to card stock. Ripped, wrinkled, or stapled. So if there's any doubt in your mind who makes the best scanners, just ask yourself a simple question. Which one would you rather go through? We have a brochure that describes all our Copiscan II scanners. For a copy, call 1-708-675-7600, or e-mail us: [copiscan@mcs.com](mailto:copiscan@mcs.com).

**BELL+HOWELL**

 The Document Management People



# 20 Contributions To Society

Computers have changed our world. That's a tired cliché, but it's true. Perhaps no other instrument of the late twentieth century has had such a fundamental and pervasive impact on our everyday lives.

## Astronomy

The Hubble Space Telescope is now fixed. But astronomers were able to salvage useful images from it even before the Space Shuttle's repair mission. Image-processing software let them extract clear images from the fuzzy ones sent down by the Hubble camera.

## Aviation

The Boeing 777 is the first of a new generation of airframes. It was designed entirely on computers, never going through mock-ups and prototypes. It represents the natural culmination of the trend toward CAD.

## Biology

The Human Genome Project, an ambitious multiyear effort to map the human genetic code, would be impossible without computers to store and sort the mountains of data nature has put into the human genetic sequence.

## Business

If, as some recent advertisements claim, business is the engine of society, then computers must be the fuel. How else could arbitrageurs force huge swings in stock prices, without computers to show them the point spreads and rapidly execute their trades before the spread closes? And how else could Federal Express track billions of packages, delivering them accurately and on time?

## Communities

On-line communities have evolved to meet almost any interest. Whether you want to rail against Barney the dinosaur, compare Captain Janeway to Captains Picard and Kirk, or trade meatloaf recipes, there is a virtual community for you somewhere. It can be tough sometimes to find those who share your interests, but they are almost surely out there.

## Consumers

The relationship between customers and manufacturers has changed. The concept of beta testing was foreign to most of the population 20 years ago. Would anyone have bought an automatic transmission if the manufacturer told you that it occasionally locked up and sometimes rebooted to first gear for no apparent reason? Yet we accept software that way.

## Education

The coming of the information age is forcing schools to rethink curricula, which they probably should do anyway. Unfortunately, some schools insist on using computers as glorified flash cards, transferring boring rote learning from paper to software. And some of the glitzy multimedia education tools go too far the other way, making education into a game. Somewhere in between are schools using computers to let kids run



SLOW BUSINESS IS NO BUSINESS.



WHERE WOULD INSIDER TRADING BE WITHOUT COMPUTERS?



COMPUTERS CAN ARRANGE A VACATION FROM COMPUTERS.



# 20 Contributions To Society

experiments, analyze data, and write papers in ways that could not have been imagined 20 years ago.

## Entertainment

Computers controlled the motion cameras that let George Lucas shoot all the components of a single scene separately—the Death Star, the Tie Fighters, and the Rebel ships—and then composite them into a single breathtaking piece of movie history.

## Finance

Many of us would be bankrupt paupers without the control over our finances that programs such as Quicken have brought. Even if you don't use the programs yourself, it's likely your accountant does.

## Government

Computers have created an industry that provides jobs for thousands of intelligent people who might otherwise be burdens on society—or worse, government bureaucrats. Thank your lucky stars.

## Health Care

Computers empower the physically challenged to lead productive lives; the brilliant physicist Stephen W. Hawking is an excellent example. He suffers from the degenerative muscle disease (amyotrophic lateral sclerosis) popularly called Lou Gehrig's disease. Although he cannot use his own voice to speak or his own hands to

write, he continues to contribute world-class science.

## Manufacturing

Just-in-time manufacturing, which seeks to reduce inventory while increasing responsiveness to changing markets, would not be possible without computers.

## Medicine

Noninvasive imaging technologies, such as CAT (computerized axial tomography) scans, have given doctors the ability to perform exploratory surgery without ever opening up the body. Soon, computer software that was originally developed to spot Soviet tanks from satellite photos will join the doctor's arsenal as a way to identify possible cancers in a mammogram.

## Meteorology

The percentage of incorrect weather reports has been dropping, due in large part to better weather models. The recently announced vBNS (very high-speed Backbone Network Service) will let several supercomputers work together on much larger simulations, which should further improve the accuracy of forecasts.

## Military

As the Gulf War showed us, technical superiority can overwhelm numerical superiority. Getting there first with the most is no longer as important as having the most advanced weapons. Computer-controlled weapons help a small, well-equipped armed force keep the peace in a dangerous world.

## Physics

A physicist with some new theories on star formation runs a simulation based on her new theories to test it out. Another seeking the basic quantum particles examines the remains of a proton/antiproton collision, like some voodoo priest examining the entrails of matter rather than the entrails of chickens.

## Politics

During his recent unsuccessful run for the U.S. Senate, Oliver North was able to raise millions of dollars from outside his state, using mailing lists of like-minded individuals. A state-level operation never could have handled such a sophisticated, nationwide fund-raising effort without cheap, sophisticated databases.

## Publishing

The very definition of a magazine is changing. It is now de rigueur to have a Web page on the Internet's WWW (World Wide Web). Bandwidth for most users is still too narrow to allow fully formatted pages of text and graphics, and there is still too small a percentage of the population on-line. But this is changing.

In the realm of publishing on paper, now anyone with a computer and some imagination can turn out professional publications thanks to the power of desktop publishing.

## Travel

Computers have improved the way we travel, from reservation systems that instantly let us book flights anywhere to the early-warning systems that let pilots know of potentially dangerous microburst downdrafts.

## Writing

E-mail has at least temporarily stayed the death sentence of writing. Sure, the quality of some E-mail is less than stellar, and the temptation of easy, almost anonymous, flaming has exposed the worst side of human nature. But communicating via E-mail lets us keep in touch with a far-flung network of friends and associates.

Thanks to word processors, the task of writing has gone from chiseling in stone to sculpting from clay. It's so much easier to push and prod your words when they are glowing phosphors on a screen than when they were typed on your old IBM Selectric. We don't always take advantage of this ability, but at least it's there.



THE \$64,000,000,000 QUESTION: IS THIS AN OPPORTUNITY TO TAKE A CHEAP SHOT AT MILITARY SPENDING?



# FREE PRODUCT INFORMATION

**For free product information from companies featured in this issue, circle the appropriate inquiry number below and mail this card today. For quickest response, fax to 1-416-620-9790!**

## Product Category Information

To receive information for an entire category, circle the appropriate number on the adjacent card.

### Hardware

Accessories/Supplies	1
Add-in Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Diagnostic Equipment	53
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/	
Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia/CD-ROM	19
PCMCIA	57
Printers/Plotters	20
Programmable Hardware	21
RAID Drive Arrays	56
Scanners/OCR/Digitizers	22
Security	52
Tape Drives	23
UPS/Power Management	24
Voice Technology	55

### Software

Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
OS/2	54
Programming Languages/	
Tools	40
SCSI/Peripheral Interfaces	51
Security	49
Shareware	42
Software Duplication	43
Spreadsheets	44
Unix	45
Utilities	46
Windows	47
Word Processing/DTP	48

### General

Books/Publications	49
Recruitment	50
Miscellaneous	51

**Fill out this coupon carefully. Please Print.**

Name \_\_\_\_\_ Title \_\_\_\_\_  
 Company \_\_\_\_\_ Address \_\_\_\_\_  
 City \_\_\_\_\_ Country \_\_\_\_\_ Code \_\_\_\_\_  
 Phone \_\_\_\_\_ Fax \_\_\_\_\_

A. My job function is best classified as (check one):

- 1 ☐ Company Management  
 2 ☐ IS/MIS/IT Management  
 3 ☐ Systems Engineering/Integration  
 4 ☐ Systems/Networking Consulting  
 5 ☐ Departmental Management (non-IS/MIS)  
 6 ☐ Technical Services Support  
 7 ☐ Other (please describe) \_\_\_\_\_

B. What is your organization's primary business activity at this location (check one):

- 8 ☐ Business Services (Finance, Banking, Insurance, Healthcare, Professional)  
 9 ☐ Commerce/Industry (Retail, Wholesale, Construction, Mining, Manufacturing, Transportation)  
 10 ☐ Reseller/OEM (VAR, VAD, Systems/Network Integrator, Computer Product Manufacturer)  
 11 ☐ Government (Federal, State, Municipal, Military)  
 12 ☐ Computer Services (Support, Training, Consulting)

13 ☐ Other (please specify): \_\_\_\_\_

C. Please indicate which specific fields of interest are important to you so that BYTE may serve you with supplemental information that best meets your needs (select all that apply):

- 14 ☐ UNIX and Workstations  
 15 ☐ Networking (LANs, WANs, and Telecommunications)  
 16 ☐ Multimedia  
 17 ☐ Reselling/Systems Integration  
 18 ☐ Applications Development  
 19 ☐ Other (explain): \_\_\_\_\_

D. My responsibilities require that I be involved with the following operating system environments (check all that apply):

- 20 ☐ DOS  
 21 ☐ OS/2  
 22 ☐ Mac/OS

- 23 ☐ UNIX (any, including Solaris)  
 24 ☐ Windows  
 25 ☐ Windows/NT  
 26 ☐ NetWare  
 27 ☐ Other (please describe): \_\_\_\_\_

E. The number of employees at my location and company-wide area (check one in each column):

	At My Location	Company-Wide
10,000 or more	28 <input type="checkbox"/>	33 <input type="checkbox"/>
5,000 to 9,999	29 <input type="checkbox"/>	34 <input type="checkbox"/>
1,000 to 4,999	30 <input type="checkbox"/>	35 <input type="checkbox"/>
100 to 999	31 <input type="checkbox"/>	36 <input type="checkbox"/>
Under 100	32 <input type="checkbox"/>	37 <input type="checkbox"/>

September 1995

90 97 98

Valid until November 30, 1995

## Inquiry Numbers 1-187

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187

## Inquiry Numbers 375-561

375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391
392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408
409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425
426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442
443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476
477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493
494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527
528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561

## Inquiry Numbers 749-935

749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765
766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782
783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799
800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816
817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833
834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850
851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867
868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884
885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901
902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918
919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935

## Inquiry Numbers 1123-1309

1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139
1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156
1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173
1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190
1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207
1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224
1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241
1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258
1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275
1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292
1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309

## Inquiry Numbers 188-374

188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204
205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221
222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238
239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272
273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289
290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306
307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323
324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357
358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374

## Inquiry Numbers 562-748

562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578
579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595
596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612
613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629
630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646
647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663
664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697
698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714
715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731
732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748



# FREE PRODUCT INFORMATION

*For free product information from companies featured in this issue, circle the appropriate inquiry number below and mail this card today. For quickest response, fax to 1-416-620-9790!*

See reverse side  
for card.

**1. For FREE product information from individual companies, circle the corresponding inquiry numbers on the Response Card!**

**2. Print Your Name and Address**

Answer questions "A" through "E" and mail or fax card to 1-416-620-9790

**3. Product information will be rushed to you from the selected companies!**

**BYTE**

TNT MAILFAST

FRG/BOS/700252/MO1

P.O. Box 66

Hounslow

TW5 9RT

England

Place  
Postage  
Here

**BYTE**



 **SUBSCRIBE TO BYTE!** 

With BYTE, you can compete more effectively in complex global markets...

**YES** I want to receive BYTE for a full year. (12 monthly issues)

**Payment method** — charge my subscription to:

☐ Visa ☐ Access/Eurocard/MasterCard ☐ American Express

Card No. \_\_\_\_\_ Expiry date \_\_\_\_\_

Signature \_\_\_\_\_

or ☐ I enclose payment now

Name \_\_\_\_\_ Title \_\_\_\_\_

(Please Print)

Address \_\_\_\_\_

\_\_\_\_\_ Code \_\_\_\_\_

Country \_\_\_\_\_

Please allow 8-10 weeks for processing. Thank you.

If you pay with your credit card, you will be billed in your local currency.

✓ **Tick your subscription price**

Please tick one box:

IB97326

**Fast Surface Delivery**

- ☐ £35 United Kingdom  
☐ 108 DM Germany  
☐ 366 Fr France  
☐ 120 Guilders Netherlands  
☐ 90 SFR Switzerland  
☐ 99,000 Lire Italy  
☐ \$US60 All Other Countries

**Air Delivery**

IB97474

- ☐ £49 United Kingdom  
☐ 153 DM Germany  
☐ 519 Fr France  
☐ 170 Guilders Netherlands  
☐ 128 SFR Switzerland  
☐ 140,250 Lire Italy  
☐ \$US85 All Other Countries

Your satisfaction is **GUARANTEED!**  
If you are dissatisfied, cancel anytime  
for a refund on all unmailed issues.

**Save Time! Fax 609-426-5592**

**BYTE HAS EXCLUSIVE  
GLOBAL COVERAGE...** \*

\*each month, you can take advantage of BYTE's International Section with  
hard-hitting news, and coverage of important world-wide events...

**YES** I want to receive BYTE for a full year. (12 monthly issues)

**Payment method** — charge my subscription to:

☐ Visa ☐ Access/Eurocard/MasterCard ☐ American Express

Card No. \_\_\_\_\_ Expiry date \_\_\_\_\_

Signature \_\_\_\_\_

or ☐ I enclose payment now

Name \_\_\_\_\_ Title \_\_\_\_\_

(Please Print)

Address \_\_\_\_\_

\_\_\_\_\_ Code \_\_\_\_\_

Country \_\_\_\_\_

Please allow 8-10 weeks for processing. Thank you.

If you pay with your credit card, you will be billed in your local currency.

✓ **Tick your subscription price**

Please tick one box:

IB97326

**Fast Surface Delivery**

- ☐ £35 United Kingdom  
☐ 108 DM Germany  
☐ 366 Fr France  
☐ 120 Guilders Netherlands  
☐ 90 SFR Switzerland  
☐ 99,000 Lire Italy  
☐ \$US60 All Other Countries

**Air Delivery**

IB97474

- ☐ £49 United Kingdom  
☐ 153 DM Germany  
☐ 519 Fr France  
☐ 170 Guilders Netherlands  
☐ 128 SFR Switzerland  
☐ 140,250 Lire Italy  
☐ \$US85 All Other Countries

Your satisfaction is **GUARANTEED!**  
If you are dissatisfied, cancel anytime  
for a refund on all unmailed issues.

**Save Time! Fax 609-426-5592**

... and receive up to date information on new products and emerging technologies.

 **SUBSCRIBE TO BYTE!** 



BY AIR MAIL  
PAR AVION

Place  
Stamp  
Here

**BYTE**

P.O.Box 72  
Galway  
IRELAND



**FAST & CONVENIENT!**

Have BYTE delivered direct to your door  
and never miss an issue again!

BY AIR MAIL  
PAR AVION

BY AIR MAIL  
PAR AVION

Place  
Stamp  
Here

**BYTE**

P.O.Box 72  
Galway  
IRELAND



# The 20 Most Important People

Although computers are technology, they are created by people. And the people who create them are not just one-dimensional nerds—in fact, their breadth fuels their innovation. These 20 people have made the greatest impact on microcomputing.

## ■ Dan Bricklin

Can you imagine doing business without the spreadsheet? Dan Bricklin can't. But, then, he invented it. He got the idea while sitting in a class at the Harvard Business School. As he watched the professor fill in spreadsheets on the chalkboard, he thought, Wouldn't it be nice if you could do that electronically? Bricklin designed the interface, and his partner, Bob Frankston, wrote most of the code. They released VisiCalc in 1979, an act that fomented the desktop revolution. At last, there was something useful to do on a microcomputer.

Did he know at the time how important spreadsheets would be to computing? "Well, you always believe that your product's going to be wonderful and make major changes, but you can't always depend on that. I thought it would be very useful for business, and I tried to design it to be as useful [in] as many different areas as possible."

What about today's sophisticated spreadsheet features? "For any given user, there are things that are superfluous, and for any

given user, there are things that are missing. For my needs, just being able to recalculate is 90 percent of the way there. In that case, almost everything is sufficient."

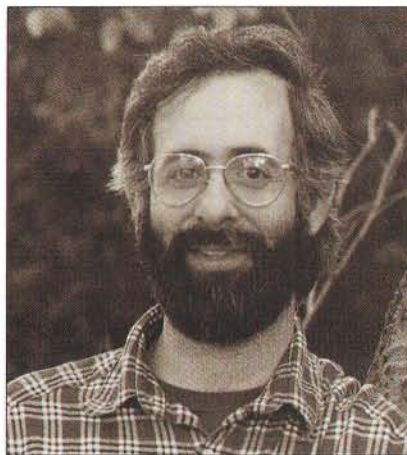
As important as VisiCalc was, the decision not to seek patent protection helped spawn an entire industry. With a patent, Bricklin could have controlled the market for 17 years. Great for him; lousy for us. "Seeing the advances that did come about from people trying different things and [being] willing to make compromises that we may not have been willing to make, I don't think the industry would have moved as far as it has."

Lotus bought the VisiCalc rights in 1985. Bricklin has gone on to design other successful, though more specialized, products but none has revolutionized computing like the spreadsheet.

## ■ Bill Gates

Here's one man who needs no introduction. Back in 1975, Bill Gates and a high school buddy, Paul Allen, wrote a version of BASIC that ran in 4 KB on the MITS Altair 8800 computer. Soon they founded Microsoft and were creating versions of BASIC and other languages for various platforms. Their Big Break came in 1980 when IBM contracted with them to write Disk Operating System, or DOS, for its new PC. Through an incredible act of charity or stupidity, IBM gave Microsoft rights to sell versions of DOS to other manufacturers.

Today, Gates is worth more money than the other 19 people on our list put together (and they include several multimillionaires). But we're here to talk technology, not tax shelters. Gates, who is about to launch Microsoft Network, recalls that he



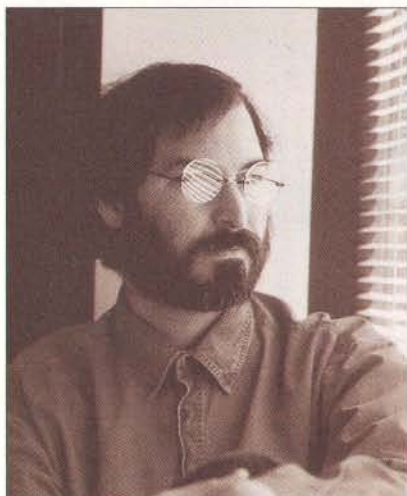
FATHER OF THE SPREADSHEET, DAN BRICKLIN.



BILL GATES: YOUR BASIC BILLIONAIRE.



## THE 20 MOST IMPORTANT PEOPLE



NEXT ON OUR LIST, STEVE JOBS.

and Allen long ago believed on-line services would be the killer application: "We thought they would catch on in the 1970s and the 1980s. We always thought that would be the defining application and it would get the things in people's homes, which definitely turns out to be true but 15

years later than we expected."

Why the delay? "What you can do with 300 baud is tricky... Then there was the small problem of a business model, how to deliver an essentially free service to people and get advertising to pay the freight. Finally, PCs lacked critical mass: Unless you get an immense number of people using it, it's of no value... We were naive to think that would spark a critical mass."

Any final thoughts? "The last big revolution in communications to have this kind of impact was the telephone. It was a two-way device, and it shrunk the world. The world became a different place."

### ■ Steve Jobs

Unless you've been stuck on a streetcar named Mobius these past 20 years, you know the saga of Steve Jobs: College dropout, garage-shop inventor, cofounder of Apple Computer, ousted in 1985 at age 30, cofounder of Next Computer. During the Apple II's heyday, he stood in the shadow of his partner, the technically superior Steve Wozniak. But his marketing moxie,

his love affair with the microphone, and his unrelenting vision for the Macintosh, released in 1984 with a revolutionary GUI, catapulted Jobs beyond the limelight.

As the name brashly implies, Jobs hoped the Next would be the next killer machine. But with an \$11,000 price tag, even a high-tech Billy Graham couldn't win many converts. "We knew we'd either be the last hardware company that made it or the first that didn't, and we were the first that didn't." He's repositioned Next and now wants to be the main man in object technology. "I went to Xerox PARC in 1979, and I saw the Alto. There was a crude graphical user interface on it... within 10 minutes it was obvious that all computers would work this way someday. Objects are the same way. Once you understand what objects are, you realize that all software will be written using objects, object technology."

What does this innovator think of today's interfaces? "The Mac has been dead in the water since 1985 in terms of its user interface. And Windows is still a sort of

## TRANSFORMED BY LINCOLN.





## THE 20 MOST IMPORTANT PEOPLE

caricature of the Mac. Windows 95 doesn't really get it. The user interface is not very good."

Never short on bombast, Jobs likens today's GUI situation to TV. "You think it's a conspiracy [by] the networks to put bad shows on TV. But the shows are bad because that's what people want. It's not like Windows users don't have any power. I think they are happy with Windows, and that's an incredibly depressing thought."

### ■ Robert Noyce

Can you imagine saying Germanium Gulch instead of Silicon Valley? Thank Mother Nature and Robert Noyce for sparing us from that mouth mangler. Here's why.

In late 1958, a young engineer at Texas Instruments named Jack Kilby placed two circuits on a single piece of germanium, hand-wired the interconnects and—presto—created the first IC. Within months, Noyce and company at Fairchild Semiconductor used a planar process they had developed to connect the components on their version of the IC. In so doing, they

discovered that the IC's conductivity was better and more controllable when silicon was used instead of germanium. To this day, Kilby and Noyce are both credited as the independent co-inventors of the IC.

Within three years, Fairchild and TI were producing affordable chips in volume using Noyce's process, a manufacturing technique that has undergone minor improvements but remains basically unchanged to this day. ICs were first used in a commercial product—a hearing aid—in 1963. By the mid-1960s, they were used widely throughout the electronics industry. Noyce went on to cofound Intel Corp. in 1968 and served as president and chairman of the board.

In mid-1988, after the U.S. chip industry had been losing market share to offshore competitors for years, Noyce was named CEO of Sematech. The government-industry consortium was established to conduct advanced computer chip R&D on behalf of its members and to advance U.S. competitiveness. It succeeded. Noyce, the son of an Iowa minister, was widely regarded as a



ROBERT NOYCE: FIRST NAME IN SILICON.

gentleman and a scholar. He died at the relatively young age of 62 in 1990.

As an aside, a few years after inventing the IC at Texas Instruments, Kilby helped toll the death knell for the time-honored slide rule when he was a member of the TI team that invented the first pocket calculator. Kilby still works as a consultant.

## POWERED BY MOTOROLA.



INTRODUCING THE PERFECT BALANCE OF LUXURY AND TECHNOLOGY. THE 1995 LINCOLN CONTINENTAL.

IT LOOKS SMART — IT IS SMART. THE BRILLIANCE OF FORD ELECTRONICS AND OUR 68HC05 MOTOROLA

MICROCONTROLLERS HAVE FASHIONED A MASTERPIECE THAT CAN DO EVERYTHING BUT YOUR TAXES. ELEGANTLY. FROM AUTOMOTIVE ELECTRONICS TO WATCH LIGHTS, PRODUCTS POWERED BY MOTOROLA ARE FAST BECOMING A WAY OF LIFE.

FOR INFORMATION CALL 1-800-521-6274.

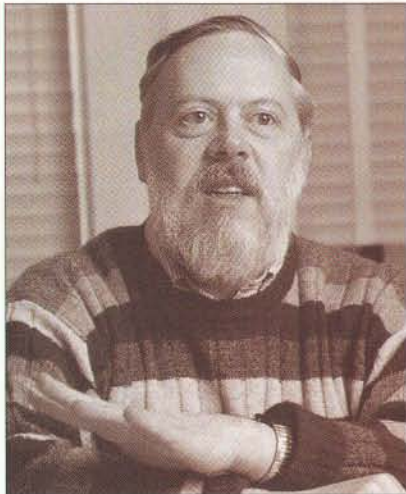


**MOTOROLA**

Semiconductor Products Sector



## THE 20 MOST IMPORTANT PEOPLE



DENNIS RITCHIE CREATED A MENACE: UNIX.

### ■ Dennis Ritchie

It took some chicanery to overcome one of the biggest hurdles to the development of Unix. And we're not talking about some kind of sleight-of-hand code writing.

Launched in 1969 as a nonprofit venture between Bell Telephone Labs, General

Electric, and MIT, the effort to create an OS for a large computer that would handle up to a thousand simultaneous users was almost scuttled early on for lack of a computer (they were really expensive in those days). Dennis Ritchie and his codevelopers, including Ken Thompson, finally suggested to BTL that it buy a PDP-11/20 for a text-preparation project. BTL regarded text preparation as something useful and spat out the seed money for the \$100,000-plus machine.

"There was a scam going on," Ritchie once recalled. "We'd promised [to develop] a word processing system, not an operating system. But by the time the full computer had arrived in the summer of 1970, work was moving at full steam on both." And thus was born Unix. The text-processing system was a success, and the patent department at BTL became the first commercial Unix user in the bargain.

Unix, for which Ritchie deserves much of the credit, was one of the major advances in computing, giving the user features and functions that were previously unthinkable.

It was not only a great advance but a great simplification, demonstrating that a relatively small OS could be portable, machine independent, and affordable. The advent of the workstation and the growth of networking have cinched Unix's place in computing. Since the late 1970s, Unix has had a profound impact on DOS, the Mac OS, Windows NT, and many others.

Ritchie and Thompson wrote the first *Unix Programmer's Manual* in 1971. Ritchie developed C, and in the early 1970s, he and Brian Kernighan coauthored *The C Programming Language*. Ritchie, now in his mid-50s, still works at AT&T research labs, where he is developing OSes, including Plan 9 from Bell Labs.

### ■ Marc Andreessen

Less than two years ago, while his classmates were still nursing graduation hangovers, Marc Andreessen, at the age of 22, cofounded Netscape Communications. The other founder is Dr. James H. Clark, founder and former chairman of Silicon Graphics, Inc. This, the youngest member

A large advertisement image showing a hand holding a black Stanley car air freshener. The freshener has a silver grille and a red light. The background is a car's interior with a view of a rainy street through the windshield. A teal banner with the text "INSPIRED BY CONVENIENCE." is at the top.

INSPIRED BY CONVENIENCE.

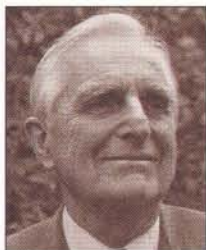


## THE 20 MOST IMPORTANT PEOPLE

of our top 20, is the latest wunderkind to compile. What Steve Jobs was to the desktop, Andreessen is to the Internet. His Netscape Navigator (née Mosaic) for PCs, Macs, and Unix machines already accounts for more than half of all Web browsing. He led the development of the prototype while he was an undergraduate at the University of Illinois. Unlike some of the other wunderkind (whose names we won't mention), Andreessen graduated from college.

### ■ Bill Atkinson

If you knew the Lisa like Bill Atkinson knew the Lisa, then you knew a lot more about the Lisa than most of us wanted to know. But from this scarlet woman, named for Steve Wozniak's daughter, came a GUI. Atkinson was the chief wizard behind its graphics engine. The Lisa begat the Mac, and the rest is history. Today, as cofounder of Apple spin-off General Magic, Atkinson wants to create technology that he hopes will be welcomed into people's lives, rather than be a source of stress—technology like Magic Cap. We also fondly recall that he



DOUG ENGELBART



GRACE MURRAY HOPPER

was the chief designer of HyperCard, the software construction kit that put Mac programming tools into the hands of millions of Mac users.

### ■ Tim Berners-Lee

If the snobs who whine about the Internet's exploding popularity ever form a vigilante posse, the first man they'll hang is Tim Berners-Lee. He's the guy behind the World Wide Web, which he developed for the CERN (European Council for Nuclear Research) in Geneva, Switzerland, so that physicists could swap data easily. Berners-Lee developed the URL, HTML, and HTTP

standards, from which he wove the Web. Since launching the Web in 1991, he has often endorsed the idea of people using it for profitable transactions. He's now at MIT, where he directs the World Wide Web Consortium, which deals with Web security and other issues. He deserves a Nobel prize of some sort.

### ■ Doug Engelbart

Got patent envy? You'll have a hard time matching this pioneer, who holds 20, most of which are on basic features in microcomputing. Imagine microcomputing without windows; or word processing; or hypermedia, E-mail, and groupware; or the Internet. Imagine microcomputing without Doug Engelbart, now 70, who for years was a fixture at Stanford Research Institute. Engelbart had a vision that computers could be more than giant adding machines; they could be tools for human beings. A few years ago, he founded the Bootstrap Institute, dedicated to getting companies to collaborate on innovation. Comparisons with Thomas Edison do not seem

## POWERED BY MOTOROLA.



NEITHER RAIN NOR SLEET NOR HAIL NOR DEAD OF NIGHT WILL STOP THE STANLEY "PREMIER" GARAGE DOOR OPENER FROM THE SWIFT COMPLETION OF ITS APPOINTED

ROUNDS. IT'S SUPER-RELIABLE BECAUSE IT COUNTS ON A MOTOROLA CUSTOM CHIP TO HANDLE LIFE'S UPS AND DOWNS.

FROM HARDWARE TO PERSONAL COMPUTERS, PRODUCTS POWERED BY MOTOROLA ARE FAST BECOMING A WAY OF LIFE.

FOR INFORMATION CALL 1-800-521-6274.



**MOTOROLA**

Semiconductor Products Sector



## THE 20 MOST IMPORTANT PEOPLE

farfetched, which reminds us: He's best known for the first mouse—a wooden rodent invented in 1963.

### ■ Grace Murray Hopper

As a child, Grace Murray Hopper liked to take apart alarm clocks. She was the first woman to earn a doctorate in math at Yale. In World War II, she joined the Navy and was assigned to its computational center at Harvard. Amazing Grace later developed the first compiler for Remington Rand's UNIVAC in the early 1950s and led the charge to create COBOL. The Navy recalled her in 1967, and she was on active duty until 1986. She died in 1992 at the age of 85 with the rank of rear admiral. Anyone who met her could not help but be awestruck by this diminutive fire storm of a human being. One picture has her stuck in purgatory, refusing to enter Heaven until St. Peter agrees to computerize. With a Lucky Strike hanging from her lip, she fires at the grand saint: "Beg your pardon, Sir, but your excuse, 'We've always done it this way,' is the most damaging phrase in the language."



PHILIPPE KAHN



DREW MAJOR

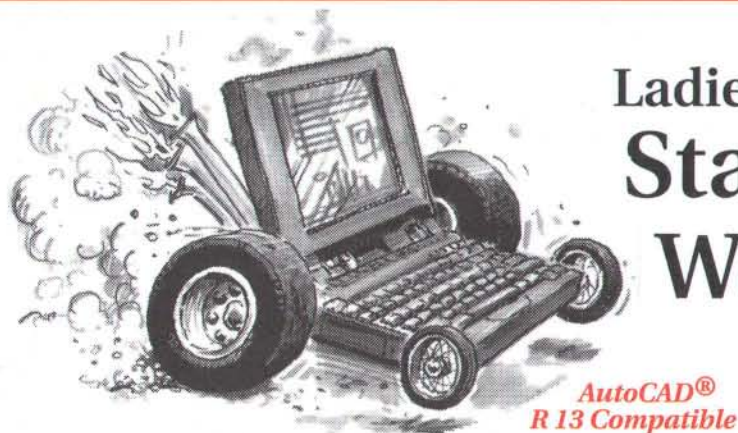
### ■ Philippe Kahn

French swagger, German determination, jazz artistry—must be Philippe Kahn. This software swashbuckler writes great compilers, plays David against Microsoft's Goliath, and never bores us. The son of a German father and a French mother, Kahn grew up in Paris. He studied Pascal with Niklaus Wirth, took a degree in math, earned money playing jazz, and developed applications on an Apple II. But Pascal compilers were too slow, so he wrote Turbo Pascal. Then he marketed it. With only \$2000 in his pocket, he landed in the U.S. with no green card and no job. He founded

Borland International in an office over an automobile repair shop in 1983. Despite the humble abode, Kahn convinced a BYTE ad salesperson to accept on credit a full-page color ad for Turbo Pascal. At a ridiculous \$49.95, Kahn was swamped with orders.

### ■ Mitch Kapor

"Software has been very, very good to me," Mitch Kapor once said. And, we add, Mitch Kapor has been very, very good to software. In 1982, he founded Lotus Development and, with Jonathan Sachs, created Lotus 1-2-3. Dan Bricklin invented the electronic spreadsheet (VisiCalc), but Kapor turned it into a more powerful, yet friendly, business tool. Lotus 1-2-3 remains the world's most widely used application. Given IBM's takeover of Lotus, it's interesting to note that Kapor once tried and failed to interest Big Blue in an exclusive marketing deal for 1-2-3. He left Lotus in 1986. In 1990, he cofounded the Electronic Frontier Foundation, a nonprofit group dedicated to understanding the social impact of the digital revolution.



## Ladies & Gentlemen, Start Your Workstations!

Tadpole Technology is the leading developer and manufacturer of portable workstation-class computers. Their modular design allows user-upgrade of memory and disks for optimal performance.

### Tadpole P1000

- First 100MHz Pentium notebook.
- Workstation-class performance for Windows, Windows 95, Windows NT and Solaris/PC UNIX users.
- Up to 128MB DRAM, 256KB write-back cache, 810MB SCSI-2 removable hard disk.
- Active 10.4" full color TFT display with 16-bit CD quality audio.
- Rugged magnesium case and more...

### SPARCbook 3 Series

- SPARCstation-class performance for Solaris UNIX users.
- MicroSPARC 50 or microSPARCII 85MHz processor with Weitek graphics accelerator
- Up to 128MB DRAM and 810MB SCSI-2 removable hard disk
- Internal ethernet, audio and video ports with PCMCIA interface.
- Durable magnesium case and more...



Rave offers in-stock availability, custom configurations, software installation and a full warranty.

Rave Computer Association is the leading reseller of remanufactured Sun Microsystems computer hardware.

### HUGE SAVINGS

Off List Price

**SPARC 1, 2, 5, 10 & 20's**  
Immediate Delivery

Call today for free brochure!

### Rave Computer Association, Inc.

36960 Metro Court  
Sterling Heights,  
MI 48312

Fax: (810) 939-8230

**1-800-966-7283**

E-Mail: sales@rave.com





# Street Machine



## Up and away on the Information-Highway!

### ONLINE NAVIGATION



### TRAFFIC INFORMATION

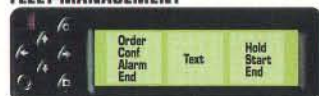


### MOBILE OFFICE



Notebook PDA

### FLEET-MANAGEMENT



### Mobile Assistant I™

— a multifunctional device for mobile communications, traffic and information management. It brings together all the latest technology such as radio modems, satellite navigation and computer power to give you the best service you can expect.

**Mobile Assistant I™** is intended for professionals in areas such as:  
Freight Carriers • Field Service Organizations • Field Sales Organizations  
• Rental Car Agencies • Police- and Fire-Departments • Emergency Road Service • Hazardous Materials and Security Transports • Public Transportation Systems.

- + Wireless Communication Computer
- + GPS, Computer, Modem
- + Just 6-Keys
- + Car Radio Size
- + Supported Networks: MODACOM/ARDIS-MOBITEK/RAM - GSM/CDPD

Circle 562 on Inquiry Card.

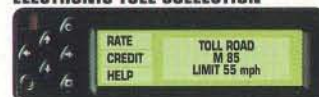
### ONLINE SERVICE



### EMERGENCY SERVICE



### ELECTRONIC TOLL COLLECTION



## ComROAD®

Internet: <http://www.solidinfo.com>




# HEADS, IT'S REAL. TAILS, IT'S FAKE.



It's your choice. A little more than 50 percent of all business software in use today is pirated. If you buy it, you could end up with virus-ridden, phony software that has no documentation or product support.

Selling or copying pirated software without authorization is against the law, with severe criminal and civil penalties including imprisonment of up to five years, fines of up to \$250,000, or both. If you suspect the sale or use of pirated software, call the BSA Anti-Piracy hotline:

 (800) 688-BSA1 (2721)



© 1993 Business Software Alliance. All rights reserved.

## THE 20 MOST IMPORTANT PEOPLE

### ■ Donald Knuth

Nearly 20 years ago, while Donald Knuth was proofing galleys for the second edition of the first volume in his *The Art of Programming* magnum opus, it hit him: A book of 0s and 1s doesn't have to be ugly. The result was a 10-year hiatus from his *Art* series to develop TEX, a typesetting language for scientific publishing, and Metafont, an alphabet design system. Then the prolific scholar/programmer knocked out six books to explain them. (Now *there's* a word processor.) Now professor emeritus at Stanford, his fourth *Art* volume of a planned seven is in press. Oh, he's also a biblical scholar, having written *3:16 Bible Texts Illuminated*, a history that examines chapter 3, verse 16 in each of the Bible's 59 books.

### ■ Thomas Kurtz

Overkill. That's what Thomas Kurtz thinks of today's software. "The public has been sold the most complicated word processing systems imaginable, when all they want to do is to write a letter." Aching for simplicity in a computer programming language, Kurtz and John Kemeny codeveloped BASIC in 1964. It has its detractors, but BASIC is still bundled on virtually every microcomputer sold. They never copyrighted it, so dozens of variations appeared. This horrified the Drs. K, who dubbed the dialects "Street BASIC." In the 1980s, they formed a company to develop True BASIC, a lean version that meets ANSI and ISO standards. Kurtz is currently a professor emeritus at Dartmouth. Kemeny, once president of Dartmouth, died in 1992.

### ■ Drew Major

As Drew Major sees it, "In the next [computer] generation, nothing will not be connected." But what would you expect from Major, chief scientist at Novell and lead architect of NetWare, still the preeminent NOS (network OS). Fresh out of Brigham Young University in 1980, Major and two buddies took a six-week consulting job at Novell (which was trying to make CP/M machines) and wound up staying 15 years. When NetWare 3.0 shipped in 1989, it contained server-based applications called NLMs (NetWare loadable modules), a great leap forward over the kludgy VAPs (value-added processes) of the previous version. How bad were VAPs? They're the only thing about NetWare that Major ever apolo-



JOHN WARNOCK



STEVE WOZNIAC

gized for. Undoubtedly, his mother taught him to be polite.

### ■ Robert Metcalfe

For five points, what came first: commercially sold PCs or the LAN? Robert Metcalfe knows. He outlined local networking technology in his doctoral dissertation at Harvard. In 1973, he went to Xerox PARC, where he invented Ethernet to connect the Alto computers (never sold commercially) in use there. Thus, the LAN was born before the first PCs were marketed. Today Ethernet connects more than 50 million computers. In 1979, Metcalfe founded 3Com, a networking company. He retired in 1990 and was publisher of *InfoWorld* for 2½ years. So what does the Father of Ethernet think about the information highway? A fad. "Soon the fad will be over," he says. "Then we can get back to the business of building I-ways—another 50 years of plumbing."

### ■ Bjarne Stroustrup

Perhaps because their native tongues are not widely spoken, Scandinavians are noted for their multilingual talents. So it's no surprise that C++ inventor Bjarne Stroustrup, a native of Denmark, rejects any notion of a universal programming language: "...the idea of spanning the whole spectrum of programming with one language is absurd." In the mid-1980s, Stroustrup, head of Bell Labs' large-scale programming research department, defined the C++ object-oriented extension of the C language. He also authored two notable works on C++, including *The C++ Programming Language*. To those who whine about how hard C++ is to use, he says: "It wasn't meant to be learned in 2 hours."

### ■ John Warnock

Two innovations clearly sparked the desktop publishing revolution: The Mac and



**When you paid extra for SCSI bus performance,  
this probably wasn't what you had in mind.**



**Aeronics' new 68 Position IDC 0.025 Pitch Ribbon Cable Terminator will give your SCSI bus a boost.**

**Why does my bus need a boost?**

Peripheral devices such as hard drives, CD-ROM drives, scanners, and printers that are interfaced with your computer have connectors manufactured by different companies that are connected to cable made by who-knows-who. Differences in peripheral cabling and connectors create signal impedance mismatches which can cause signalling errors, bottlenecks, and data transmission errors.

**Aeronics has the answers.**

Aeronics, the originator of Forced Perfect Termination (FPT), has added a new interconnect product to our family of high performance terminators that will drastically improve your SCSI bus performance.



Aeronics' new 68 Position IDC 0.025 Pitch Ribbon Cable Terminator easily clamps onto your ribbon cable with a standard tool and replaces the low performance passive terminators frequently furnished by

peripheral manufacturers. For those active negation drivers that generate higher than normal pull-up voltages that tend to overdrive the SCSI bus, Aeronics has developed the ALT-2ANHC. This new electrical configuration sinks unusual amounts of current due to charged cable capacitance and is available in most of Aeronics' interconnect products.

**How does Aeronics boost my bus?**

Aeronics' FPT active terminators purposely mismatch impedance higher and lower than the impedance of the transmission line, "forcing" the SCSI bus to operate as if the impedance between the host and peripherals is always matched. Because our terminators

provide higher noise immunity, results are seen as improved data integrity, allowing your system to transfer data farther and faster while improving overall SCSI reliability.

**Terminate your SCSI bus performance problems once and for all.**

Aeronics' advanced terminator technology is available in a broad line of connection and electrical configurations that meet or exceed ANSI SCSI 1, 2, and 3 standards. Our passive, active, FPT, and differential terminators are 100% electrically tested, burned in, and delivered on time. With a minimum MTBF of 87,600 hours (10 years continuous duty), our quality terminators are backed by a limited lifetime warranty.

Aeronics' high performance products leave passive and copycat terminators in the dust. If you want the same performance that high-end OEM SCSI systems have, choose the same terminator from Aeronics and give your bus a boost. Call or fax Aeronics today for the location of the reseller or distributor nearest you.

**For off-the-shelf delivery, call TCC at  
1-800-TEC CABL (1-800-832-2225).**



*Turning concepts into reality.*

12741 Research Blvd. • Suite 500 • Austin, TX 78759  
Tel (512) 258-8040 • Fax (512) 258-8441



# Save Disk Space

# PKZIP

## PKZIP version 2.0

PC WORLD



WORLD CLASS  
AWARD

PKWARE® introduces the next generation of its award winning compression utility. PKZIP 2.0 yields greater performance levels than achieved with previous releases of the software. PKZIP compresses and archives files. This saves disk space and reduces file transfer time.

Software developers! You can significantly reduce product duplication costs by decreasing the number of disks required to distribute your applications. Call for Distribution License information.

## Put Your Executables on a Diet

Software developers! Save disk space and media costs with smaller executables. You can distribute your software in a compressed form with PKLITE Professional.\* PKLITE Professional gives you the ability to compress files so that they cannot be expanded by PKLITE. This discourages reverse engineering of your programs.



PKLITE increases your valuable disk space by compressing DOS executable (.EXE and .COM) files by an average of 45%. The operation of PKLITE is transparent, all you will notice is more available disk space!

## Compression for YOUR Application



The PKWARE Data Compression Library\* allows you to incorporate data compression technology into your software applications. The application program controls all the input and output of data, allowing data to be compressed or extracted to or from any device or area of memory.

All Purpose Data Compression Algorithm compresses ASCII or binary data quickly. The routines can be used with many popular DOS languages. A Windows DLL and an OS/2 32-bit version is also available!

# PKWARE® INC.

The Data Compression Experts®

9025 N. Deerwood Drive Brown Deer, WI 53223-2437

(414) 354-8699 Fax (414) 354-8559

PKWARE, INC. WEB SITE # <http://www.pkware.com>

PKWARE Data Compression Library for DOS \$275 PKWARE Data Compression Library for OS/2 \$350

PKWARE Data Compression Library DLL for Windows \$350

PKZIP \$47.00 PKLITE \$46.00 PKLITE Professional \$146.00

Please add \$5.00 S&H per package in the US & Canada. \$11.25 overseas.

Wisconsin residents add appropriate state sales tax & county sales tax.

Visa and Mastercard accepted, no COD orders.

BY995

## IMPORTANT PEOPLE

John Warnock's Postscript PDL (page-description language). Warnock cut his teeth at Xerox PARC, where he developed graphics imaging standards. In 1982, he and his partner, Charles Geschke, founded Adobe Systems to create pioneering software products for desktop publishing and electronic document technology. As millions of computer users begin to wander the information highway, Warnock sees a day when cross-platform document and graphics standards will be a reality. "I think meaningful document standards will emerge over the next five years. There is a need for an abstraction layer that is independent of operating systems."

### ■ Niklaus Wirth

Pascal begat Modula 2. Modula 2 begat Oberon. And Niklaus Wirth begat them all. Wirth, of the Swiss Federal Institute of Technology, likes to quote Albert Einstein: "Make it as simple as possible but not simpler." Much of today's software is overweight and inefficient. Wirth is showing a simpler way with OOP (object-oriented programming). His latest, Oberon (a language and an OS), lets developers reuse built-in data structures without recompiling the entire OS. Applications are replaced by leaner tools that the OS can access on demand. One result: fewer bugs. Need more proof? The Oberon PC version, including a GUI, uses 1.5 MB of RAM; Microsoft Windows 3.1 needs 4 MB.

### ■ Steve Wozniak

Consider Steve Wozniak, the Wizard of Woz, the Ultimate Hacker, one of the great garage inventors of all time. With the millions he earned when Apple went public, Woz no longer works like the rest of us. The Father of the Apple II (don't worry, the other Steve gets some credit, but it was Woz's baby) now throws his energy into helping youths learn computers. "I believe more and more we should support the people who are not computer experts." He not only spends hundreds of hours teaching, he also personally picks up the cost of AOL accounts for about 100 kids. "The worst problem isn't so much students, but teachers really need forced training. It costs money. The school board has to sit back and reprioritize what is going to be taught."



# NEW!



## CorelDRAW 6 is here!!!

With awesome speed, power and accuracy plus hundreds of enhancements,

**CorelDRAW 6 - Multiple Document Interface, increased speed and power**



**CorelDREAM 3D 6 - Powerful 3D software with easy-to-use CorelDRAW interface**



**Corel PRESENTS 6 - CorelMOVE, CorelCHART and CorelSHOW integrated into one professional presentation module**



**Corel PHOTO-PAINT 6 - More speed, unlimited file size support**



CorelDRAW 6 reaches a new level of graphics productivity. CorelDRAW 6 offers fully-featured software applications for illustration, photo-editing and bitmap creation, business and multimedia presentations and 3D rendering. Plus nine great utilities and incredible libraries.

### Includes

- CorelDRAW 6
- Corel PHOTO-PAINT 6
- Corel PRESENTS 6
- CorelDREAM 3D 6

### Plus

- 25,000 clipart images and symbols
- 1,000 photos
- 1,000 TrueType® and Type 1 fonts
- Over 500 3D models



Microsoft  
**Windows 95**

Circle 219 on Inquiry Card.

**ASAP**  
ASAP SOFTWARE EXPRESS, INC.™  
**1-800-248-2727**

CorelDRAW 6  
**\$429.99\***  
CD-ROM Version

Special pricing valid through August 30, 1995.

\*US\$ plus applicable taxes

**COREL**  
custserv@corel.ca  
Call now for faxed literature!  
1-613-728-0826 ext. 3080  
Document #1082

KUP-0114



# SCEPTRE MAKES A MONITOR FOR EVERY APPLICATION, INCLUDING YOURS



**11.3" LCD Monitor**

\*CC-617GL+ Viewable Diagonal Screen Size = 15.9" (17" CRT)

\*CC-615GL+ Viewable Diagonal Screen Size = 13.9" (15" CRT)

\*CC-717GL+ Multimedia

Viewable Diagonal Screen Size = 15.7" (17" CRT)

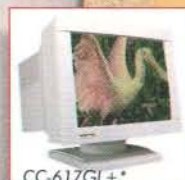
\*CE-6NGL Viewable Diagonal Screen Size = 12.8" (14" CRT)

\*CS-621 Viewable Diagonal Screen Size = 19.8" (21" CRT)

All screen images simulated



CC-615GL+



CC-617GL+



CC-717GL+ Multimedia



CE-6NGL



CS-621

More than 10 years of ongoing research and development and a large investment in unique technology have produced a family of quality computer monitors. There is a razor sharp, flicker free, static free, low radiation Sceptre monitor to fit virtually every application—and every location.

We even manufacture the remarkable new LCD flat panel display monitor. It's detachable 11.3" screen is less than 2" thick, weighs 2.8 pounds and can be wall-mounted when work space is at a premium.

Sceptre monitors have never looked so brilliant. Call

**1-800-788-2878.**

SEE US AT  
**COMDEX/Fall'95**  
BOOTH #54444

## SCEPTRE®

EXCELLENCE FOR ALL THE WORLD TO SEE

SCEPTRE donates a portion of all profits to the Zoological Society of San Diego in support of C.R.E.S., the Center for Reproduction of Endangered Species.

© 1995 SCEPTRE Technologies, Inc. All Rights Reserved. All product and brand names are trademarks or registered trademarks of their respective companies.

Circle 260 on Inquiry Card (RESELLERS: 261).





# 20 Spectacular Failures

Sometimes you get it; sometimes you don't. Why should computer companies be any different? There doesn't seem to be a single one that has the complete Midas touch.

## ■ Apple III

*Apple Computer*

Apple's first designed-for-business computer was plagued with hardware gremlins after its 1980 debut. Or perhaps gremlins isn't the right word—ogres might be more accurate. At one point, Apple advised users of malfunctioning units to lift their machine several inches off the desktop and then drop it—to reseal loose chips. The Apple III engineering group was disbanded in 1984.

## ■ VisiOn

*VisiCorp*

This integrated software package had a slick windowing interface and was supposed to be the smash-hit sequel to VisiCalc, the first spreadsheet program. But two years after it appeared in 1982, VisiOn was "visioff."

## ■ MSX

*Microsoft*

You think everything Microsoft touches turns to gold? Think again. MSX, a Z80-based computer standard developed with several Japanese companies in 1983, flopped so badly that only a handful of MSX machines were ever sold in the U.S. Somehow Microsoft survived.

## ■ Lisa

*Apple Computer*

With 1 MB of RAM, 2 MB of ROM, a 5-MB hard drive, and the first GUI ever seen on a personal computer, the Lisa was a breakthrough machine in 1983. It cost \$10,000 and crawled like a slug, however. When the Macintosh arrived in 1984 at \$2495, the Lisa was doomed. In 1989, the last 2700 Lisas were buried in a Utah landfill.

## ■ Aquarius

*Mattel*

When Mattel demonstrated this computer at a trade show in 1983, employees had to conceal one of the keys with masking tape. For some bizarre reason known only to Mattel engineers, the Aquarius had a convenient key that instantly rebooted the computer and wiped out all your data.

## ■ DEC Rainbow

*Digital Equipment Corp.*

In the early 1980s, several companies tried to sell computers that ran MS-DOS but weren't IBM PC-compatible. One was the DEC Rainbow, which became famous as the computer that couldn't format its own floppy disks. You had to buy preformatted blank disks from DEC—at a considerable markup. The Rainbow quickly faded in 1985.

## ■ Gavilan Mobile Computer

*Gavilan Computer Corp.*

This early 8088-based laptop had an eight-line LCD screen, an innovative touchpad, and an optional printer that attached to the back. But it wasn't PC-compatible and suffered from technical problems. In 1984, a Gavilan executive announced, "The microcomputer industry is entering a new chapter—Chapter 11."



DIM PROSPECTS FOR DATA GENERAL.



APPLE'S LISA: BEAT OUT BY A GUY NAMED MAC.



## ■ Adam

*Coleco*

For the incredibly low price of \$599, eager buyers got a Z80-based home computer with a daisy-wheel printer, a 512-KB tape drive, and bundled software—luxurious features in 1984. But the Adam was so poorly designed that it sometimes erased its own tapes during boot-up. It was nicknamed the “Adam bomb.”

## ■ PCjr

*IBM*

This cruelly crippled cousin of the IBM PC was supposed to conquer the home market in 1984. Instead, it was overshadowed by Apple's launch of the Macintosh, and its chiclet keyboard and sky-high price drove away hordes of buyers. The PCjr died a laughtingstock in 1985.

## ■ Mindset PC

*Mindset*

Too far ahead of its time, the Mindset tried to bring dazzling color graphics to business users in 1984. Unfortunately, it wasn't com-



GAVILAN HAD THE RIGHT IDEA BUT WASN'T PC.

pletely PC-compatible, and most business users thought color graphics were for game machines. (Little did they know....) However, the Mindset became the first computer in the New York Museum of Modern Art's permanent industrial collection.

## ■ DG/One

*Data General*

This 10-pound laptop had a 12-inch LCD screen, a mighty impressive feature in

1984. In theory, anyway: The nonbacklit screen was almost readable if the light was just right and you had the vision of Superman. Most people didn't.

## ■ Osborne II

*Osborne Computer*

In 1984, Adam Osborne announced that he would introduce a new version of his Osborne I, the first successful portable computer. In anticipation of the Osborne II's superior features and performance, sales of the Osborne I plummeted. When the Osborne II was delayed, the company's finances plummeted. Within months, Osborne was in bankruptcy court.

## ■ Jazz

*Lotus Development*

This 1985 integrated software package was supposed to turn the Mac into a whiz-bang business machine. But most reviewers said that Jazz didn't boogie, and Microsoft Excel outsold it 3 to 1. After Microsoft introduced its own integrated software, Works, Jazz sang the blues.

PEABODY, HERE...  
WITH THE  
FAX-ON-DEMAND  
SYSTEM THAT  
WON'T SET YOU  
“WAY BACK.”

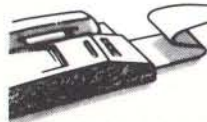


As a recognized authority in the fields of technology and history, it is no surprise that COPIA has asked me to say a few words about their FaxFacts product. After all, we are both best of breed.

- Retrieve Info via fax/voice
- Expandable to meet your needs
- U.S. Patent holder for same call fax delivery
- Fax Broadcast/Fax Mailbox
- Fax from any Windows program
- IVR provides realtime queries
- Credit Card charge per fax

**Faxfacts<sup>®</sup>**  
by Copia  
**International Ltd.**  
Wheaton, Illinois 60187  
800/689-8898

TRY THIS DEMO:  
708/924-3030  
DOC. NO. 889812



## WELCOME TO YOUR NEXT "OPEN SYSTEMS" PLATFORM — MICROSOFT WINDOWS NT™!

### FEATURED UNIX PRODUCTS FOR MICROSOFT WINDOWS NT FROM SOFTWAY AMERICA:

- Hummingbird eXceed X for Windows NT \$397  
Full featured X software for Windows NT
- B&W Connect NFS for Windows NT from \$359  
Client & server NFS solutions for NT
- MKS Toolkit for Windows NT \$199  
UNIX shell, commands & utilities for NT
- Microsoft Windows NT 3.51 Workstation \$299  
The new "Open Systems" workstation
- Microsoft Windows NT 3.51 Server from \$695  
The ultimate multi-OS server

### Other great UNIX products for Intel PCs

- UnixWare Personal Edition 2.01 \$289  
Desktop UNIX with graphics & networking
- UnixWare Application Server 2.01 \$1,095  
Unlimited user UNIX with the "works"!
- WordPerfect 6.0 for UnixWare \$331  
State of the art graphical word processing for UNIX!

Microsoft  
SOLUTION PROVIDER



Call for our complete list of UNIX products!

### BONUS!!!

Order one of our products for Windows NT today and receive a FREE shareware and sampler CD-ROM containing the hottest UNIX & internet tools for Windows NT.

All registered trademarks and trademarks are the property of their respective owners.

For years the UNIX™ system vendors have been trying to make UNIX and Windows work together on the same machine — without much luck. Now it's our turn to show you how Windows NT can be your next integrated "Open Systems" platform.

Softway America is one of the world's leading suppliers of UNIX products for Intel-based platforms. We specialize in integrating UNIX tools and networking products with Microsoft Windows NT — tools to give you NFS client/server networking, X Windows, UNIX commands & utilities and full blown UNIX development environments. On top of that we offer great prices and support on all products and a no risk 30-day money back guarantee that makes us the place to come for UNIX products!

CALL NOW...

1-800-GET-UNIX

**Softway**  
America

- GREAT PRICES
- SERVICE & SUPPORT
- SATISFACTION GUARANTEED

Softway America Incorporated  
P.O. Box 2821  
Evergreen, Colorado 80437-2821  
Phone: 303/670-5345  
Facsimile: 303/727-7618  
E-mail: sales@softway.com  
WWW: http://www.softway.com/america



# LIFE JUST GOT EASIER!

**Datapro has the  
First One-Stop, Electronic Source for Unclassified  
Information Security Documents and Directives:**

DATAPRO

**GTAC<sup>3</sup>**  
**S E R I E S**

Government  
Technologies &  
Computers,  
Communications,  
and Control

*Security and Regulations Segment*

GSA #: GS00K94AGS5102-PS01

**U**ntil now, locating unclassified  
government security information quickly –  
and keeping it in one convenient place – has  
been next to impossible.

Datapro Information Services Group's new monthly updated CD-ROM,  
"GTAC<sup>3</sup>," is the solution for quick, easy access to unclassified security data  
from sources such as:

- NCSC's "Rainbow Series"
- Carnegie-Mellon University's CERT  
Advisories
- NCSC Conference Proceedings
- Computer Security Laboratory Bulletins
- DoD Regulations
- DOE Directives
- NIST's Federal Information Processing  
Standards (FIPS)
- Public Laws

GTAC<sup>3</sup> includes over 200 unclassified documents, News Briefs, Calendar of Events – plus full  
coverage of the global information security industry.

For more information, call or fax us today.

600 Delran Parkway, Delran, NJ 08075  
Tel: 800-328-2776, 609-764-0100 Fax: 609-764-2812

McGraw-Hill House, Shoppenhangers Road  
Maidenhead, Berkshire, England SL6 2QL  
Tel: +44 1628 773277 Fax: +44 1628 773628

20 Cecil Street, 21-07 The Exchange, Singapore 0104  
Tel: +65 5384432 Fax: +65 5384436

**Datapro Information  
Services Group**

A Division of The McGraw-Hill Companies





## 20 SPECTACULAR FAILURES

### ■ TopView

IBM

Preceded by a year of hype and ballyhoo, TopView was supposed to bring multitasking to DOS programs on IBM PCs. In 1985, however, the typical PC had an 8088 or a 286 CPU with 256 to 640 KB of RAM. Hardware and compatibility problems soon dropped TopView out of sight.

### ■ Windows 1.0

Microsoft

This is the only spectacular failure that eventually made a comeback and became a spectacular success. Announced in 1983 and shipped in 1985, Windows 1.0 was so crude that it was mocked by Mac users and largely ignored by PC users. Not until Microsoft released version 3.0 in 1990 did Windows become a hit.

### ■ Access

Microsoft

We're talking about the 1985 terminal program, not the 1992 relational database. Need we say more?



PCJR: CHICLETS ARE FOR GUM—NOT FOR KEYBOARDS.

### ■ PC Convertible

IBM

Reviewers weren't exactly thrilled with IBM's first laptop in 1986. IBM retailer president Jay Rosovsky responded, "So what? It's going to sell well because it says IBM and might legitimize a lap market that's been wallowing. I don't think it's technologically great shakes." He was wrong, and he was right.

### ■ dBase IV

Ashton-Tate

Released in 1988 after long delays, dBase IV was so riddled with bugs that many users

fled back to dBase III Plus. Two years later, dBase IV 1.1 finally fixed some of the bugs, but the damage was done. Borland bought Ashton-Tate in 1991 and spent three more years porting dBase to Windows.

### ■ Momenta Pentop

Momenta

This 386-based portable pen computer could run either Windows or a proprietary GUI environment and was considered intriguing enough to make the cover of BYTE in November 1991. But it weighed 7 pounds, cost \$4995, and was hobbled by poor handwriting recognition. After its shining Momenta in the sun, the company expired in 1992.

### ■ OSI

International Standards Organization

OSI (Open Systems Interconnection) is a seven-layer reference model for network protocols that was supposed to set a new standard for interoperability. Thanks to strong backing from the federal government, it never had a chance.

YOUR FUTURE RELIES

on the  
past

h i s t o r y  
k n o w l e d g e

RELIABILITY

call 1-800-265-2797

MKS  
SOURCE  
INTEGRITY

Your source code's future depends on how well you manage its past. Development teams need to track a project's entire history and rebuild past versions quickly and accurately—with 100% assurance of reliability and integrity—every time. MKS Source Integrity (MKS RCS) does all of this—

and leverages your entire team to its maximum productivity. MKS Source Integrity is the most comprehensive software configuration management (SCM) solution for client/server development across multiple platforms. It's project oriented. And it is the only system to offer sandboxes, ensuring each developer a safe, personalized place to work.

Take a free test drive with  
MKS Source Integrity!  
Call 1-800-265-2797 today!

MKS  
NORTICE KERN SYSTEMS INC.

Phone: 519-884-2251  
Fax: 519-884-8861  
Internet: sales@mks.com  
CompuServe User ID: 73260.1043  
MKS Germany: 49-711-16714-0

Circle 76 on Inquiry Card.

Powerful features include:

- visual merging & visual differencing
- full integration into Visual C++, Borland C++, Visual Basic and File Manager
- reporting capabilities for all management needs
- configuration language and event triggers
- industry leading Make/Configuration Builder
- unprecedented security and management with NetWare integration
- unlimited branching & merging, file locking
- support for source, text, graphics, binaries, libraries & spreadsheets
- documented API available

More than 30,000 sites depend on MKS Source Integrity for their critical development needs. Because effective source code management today makes your team more productive tomorrow.

**30 day unconditional money back guarantee.**

MKS RCS and MKS Source Integrity are trademarks of Nortice Kern Systems Inc. All other trademarks acknowledged.

\*If Cognos, Gupta, Microsoft, and Powersoft all want you to be able to use Nortice Kern Systems (RCS) software configuration management tool with their development tools (and they've all built in hooks), maybe you should check it out. Datamation, August 1994.



# Smart Connectivity does more than simply get you from here to there.

It connects you simply, easily, and securely.



you



endless solutions. Smart Connectivity gives

you the power to quickly go



where you need to go.

It gives you



the freedom to navigate the



information age. Smart Connectivity works seamlessly and



keeps pace with your changing needs.



Smart Connectivity offers solutions for success.

## SMARTERM<sup>®</sup> is Smart Connectivity.

SmarTerm offers smart emulation and TCP/IP connectivity choices for Windows, 32-bit Windows, and DOS. SmarTerm is the most precise terminal emulation for UNIX, VAX/VMS, MV, and AViiON hosts and includes TCP/IP (a Windows Sockets DLL) and LAT protocol stacks. It works in every network environment—both Ethernet or Token Ring. SmarTerm is easy to use and support with its powerful automation tools and top-notch Technical Support Team.

**Evaluate SmarTerm's Smart Connectivity.  
Call Persoft today at 1-800-368-5283.**

Persoft, Inc., 465 Science Dr., P.O. Box 44953, Madison, Wisconsin 53744-4953 U.S.A.  
Phone (608)273-6000, FAX (608)273-8227

Persoft Inc, European Headquarters, Lower Woodend Barns, Fawley, Henley-on-Thames, Oxfordshire, RG9 6JF, United Kingdom  
Phone +44 (0)1491 638090, Fax +44 (0)1491 638010

Copyright 1995 Persoft, Inc. All Rights Reserved. SmarTerm and Persoft are registered trademarks of Persoft, Inc. All other trademarks are property of their respective owners.

Circle 234 on Inquiry Card.



*"PC Week Labs recommends SmarTerm..."*

*-Michael Blakely, PC Week*

**persoft**

CONNECTIVITY SOLUTIONS  
DOS • Windows • Ethernet • Token Ring





## What You Protect Is Your Business. Keeping It Protected Is Ours.

Most people don't know it, but Software Security's advanced protection technology safeguards and enhances a wide range of products in addition to commercial software applications.

We protect the firmware used in manufacturing processes and voice processing systems. Companion disks for college textbooks. Proprietary data and applications used by companies throughout the world.

Our technology is also used to deliver pay-per-access information retrieval capabilities, to guarantee 100% software registration, to ensure secure electronic transactions and much more. Including, of course, to protect software.

Software Security knows that no matter what you're protecting, what you're really protecting is your business. And we have more ways than anyone else to keep it safe. Including the industry's most powerful hardware-based solutions, network license management, software metering, and remote transaction capabilities.

If your company has developed technology that shouldn't fall into just anyone's hands, contact Software Security today at **800-841-1316**. After all, protection isn't just our business. It's yours.

**SOFTWARE SECURITY** 

6 THORNDAL CIRCLE DARIEN, CT 06820-5421 203-656-3000 Fax: 203-656-3932 BBS: 203-656-3928  
Software Security International, Ltd., London: +44-(0) 1784-430-060 Fax: +44-(0) 1784-430-050

Minsk, SSI Belarus: +(7) 0172-45-21-03 Germany, STS: 0130 811257 France, Micro Sigma: +33 146 22 9988 Italy, Tecnosoft SRL: +39 22692 2888  
Bulgaria, Synthesis Soft: +3592 655010 Netherlands, B-Tree Software: +31 30 881008 Denmark, Infolex Software: +45 53517033  
Norway, Ravenholm Computing A/S: +47 2211 0950 Finland, Xi-Tech Oy AB: +358 0628 486 Australia, CEANET: +61 2 922-6311

Circle 246 on Inquiry Card.



# Noted & Notorious Hacker Feats

Hackerdom is divided into two parts: technologically adept and clever people, who could write a computer game in a night, and, sadly, irresponsible slimeballs, who hijack computer and phone systems for the heck of it. Here is a look at some of the amazing stunts that have been pulled by both hackers and crackers.

## ■ Breaking, Stealing, and Phone-phreaking

When Kevin D. Mitnick was finally bagged by the FBI on February 15, 1995, in Raleigh, North Carolina, he had been on the lam since 1992 from a three-year probation—part of his sentence from a 1989 conviction for stealing software from DEC. This accomplishment made him the first person convicted under a law against gaining access to an interstate computer network for criminal purposes. Mitnick also did a year in the slammer for that one. Physicist and computer security expert Tsutomu Shimomura assisted authorities in tracking Mitnick down this time, after Mitnick invaded Shimomura's own computer during an assault on San Diego Supercomputer Center systems. If the latest allegations stick, Mitnick faces a somewhat more stable future of up to 35 years in

prison and \$500,000 in fines.

Besides stealing DEC's VMS OS—valued by DEC at a million dollars—and necessitating some 18 months and \$160,000 on DEC's part to defend its compromised computers and track him down, other alleged feats on Mitnick's résumé include breaking into a California motor vehicles database, lifting 20,000 credit card account numbers from an on-line service, gaining control of New York and California telephone switching hubs via modem, eavesdropping on phone calls, mutating basic home telephones into quarter-demanding pay phones, and stashing data he filched from other networks in files of the California-based Well on-line service.

In addition to typing skills, Mitnick apparently has a knack for keeping a step ahead of pursuers by perusing their plans on their own E-mail systems, scanning police bands for mentions of his whereabouts, and using cellular phones. Mitnick has an interesting system for getting systems administrators to bestow upon him network access codes, passwords, and privileged status for accounts he controls—the keys to their computer kingdoms: He asks them to, disguising his true identity and offering some plausible tale. During his stays in jail, he is routinely forbidden to dial telephone numbers himself lest he wreak some phone-phreaking black magic havoc. He has denied ever cracking the NORAD (North American Air Defense) Command computer, a rumored exploit that supposedly inspired the movie *War Games*.

## ■ The Worm That Roared

At 8 p.m. on November 2, 1988, 22-year-old Cornell University graduate student



KEVIN MITNICK: A PHREAKER SO DANGEROUS SOMEONE ELSE MUST PLACE HIS ONE PHONE CALL.



HERE HE IS, A MAN WHO WORMED HIS WAY INTO OUR HEARTS: ROBERT MORRIS.





YES, THERE IS JOY IN MUDVILLE—BILL JOY, THAT IS, INVENTOR OF A HOST OF UNIX UTILITIES.

Robert Tappan Morris launched a worm program that he had written from an MIT account. Imagine his surprise upon learning that his worm—designed specifically to traverse the Internet autonomously, finesse Unix loopholes he had laboriously researched, exploit the eccentricities of sendmail, scan lists of addresses for weak links, fool investigators into thinking it came from Berkeley, guess at passwords using a list of hundreds of common ones, and duplicate itself ceaselessly—was causing trouble on the network.

This computer cancer multiplied exponentially, filling up memories, stuffing disk drives, and consuming execution resources until machines began crashing one after another. Within hours, more than 6000 computer systems—fully one-tenth of the Internet—had been brought to their knees, affecting businesses, universities, the federal government, NASA, and the Air Force. Days of round-the-clock work were required to purge the infection from the systems and remedy the injury that had been done. Workers and researchers lost days of active computer time. A new government team of experts, CERT (Computer Emergency Response Team), was organized specifically to deal with any future incidents like the Morris worm.

Because he had discussed his worm-to-be with friends for weeks before launch day, it did not take authorities long to put two and two together and zero in on Morris. One of the first to be tried and convicted under the

Computer Fraud and Abuse Act of 1986, Morris faced possible sentences of up to five years in prison and \$250,000 in fines but received a slap on the wrist: only three years of probation, 400 hours of community service, and a \$10,000 fine. It was pointed out by his defense that the worm did not actually delete or modify any files—small comfort to those who had to deal with the mess and whose cost estimates ranged from a modest \$15 million to over \$100 million. Morris said he meant no harm.

## ■ Like Father, Like Son

Robert Morris, Sr., Robert T. Morris's father and by odd coincidence a computer security expert with the National Security Agency, used to vie with rival Ken Thompson, one of the inventors of Unix, when both worked for Bell Labs. Legend has it that Morris, Sr., once typed two specific characters into a terminal and brought down one of the first versions of Multics. *Déjà vu.*

## ■ The 75-Cent Solution

Clifford Stoll, by training an astronomer, by occupation a systems administrator at Lawrence Berkeley Laboratory, was investigating a 75-cent discrepancy in a supposedly defunct computer account that seemed to have been commandeered by an unauthorized user. The intruder was giving himself system privileges and creating accounts with names like Hunter, Jaeger, Benson, and Hedges. Although Stoll could have simply changed passwords, reassigned privileges, and so forth—effectively slamming the door on the intruder—he chose instead to monitor the intruder's on-line activity in the system. What the intruder was doing was using the LBL computers as a jumping-off point into the Arpanet, and then the Milnet (an unclassified military network), and thence to various Department of Defense computers on bases nationwide. From the files being examined, it was clear that the intruder was looking for secret American military information. Stoll was on the trail of a hacker spy.

The investigation took months, then years. By rigging connections that would page him whenever the intruder struck, Stoll was able to trace the connection back from LBL to a Tymnet node in McLean, Virginia, then to a bank of modems at Mitre Corp., and finally to West Germany. Stoll's girlfriend suggested using fake files as bait,

a successful ruse that got the intruder to request defense information by mail, giving a name and address of one affiliate of the intruder. At that point, local police, the FBI, and the CIA became involved.

The intruder, it turned out, was one of a group of young German men hoping to get rich quick by peddling stolen software and information to the Soviet KGB. They began by selling stolen DEC software, then pilfered nonvital defense-related documents, and ended by selling each other down the river. Of the group, Karl Koch (aka Hagbard Celine, a fictional character that is, by contrast, a hero) committed suicide or was murdered—no one ever determined which; Hans Huebner (aka Pengo, a penguin in a computer game) had all charges dropped due to his tender years; Dirk-Otto Brzezinski (or Dob) received a 14-month sentence and a \$2500 fine; Peter Carl received a two-year sentence and a \$1500 fine; and Markus Hess (the actual intruder with a penchant for certain brands of cigarettes) received a 20-month sentence and a \$5000 fine. None of the defendants served any time. Stoll testified at the trial and later wrote a book about his experience, *The Cuckoo's Egg* (Doubleday, 1989).

## ■ Uncrackable Code Creator

It's not often that one programmer gets to define an entire genre of software, but Philip Zimmerman has done it. His PGP (Pretty Good Privacy) is a freeware program that uses RSA (Rivest-Shamir-Adleman)-style public-key encryption algorithms to create secure encrypted versions of sensitive documents that can be sent over the Internet as E-mail without fear of compromise. The intended recipient then uses his or her code to decrypt the document. The security of the algorithm is

**5 YEARS AGO IN**

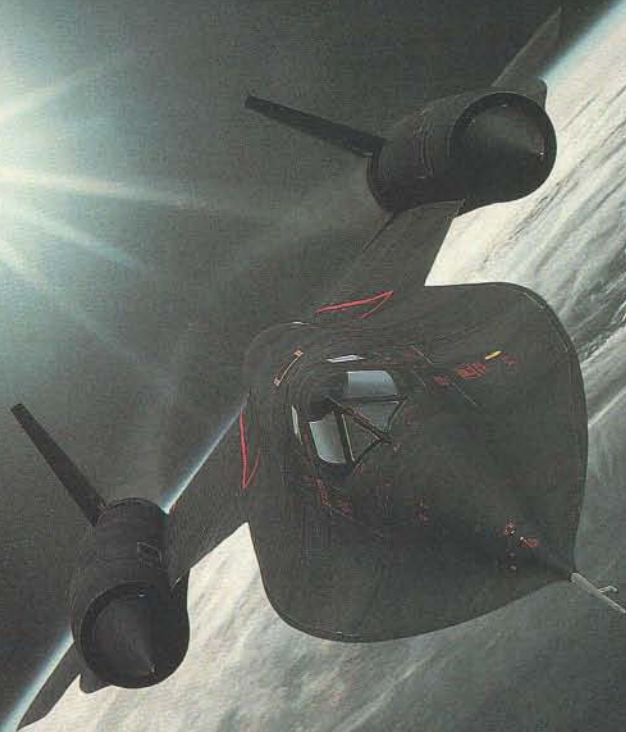
**BYTE**

Our cover story told DOS PC users to rejoice. Why? "Windows will breathe new life into your machine."

The Dow Jones broke the 2900 barrier for the first time.



**Typhoon**  
PRINTERS  
by Dataproducts



**FOR THE ULTIMATE IN PERFORMANCE...**  
**POWER UP A 1200 DPI TYPHOON 8!**

Dataproducts' Typhoon 8 is the ultimate desktop printer. With stunning, typeset-quality 1200 dpi resolution, full-bleed 11" x 17" imaging, Adobe PostScript® Level 2, PCL 5 and now, *free* camera-ready faxing, the Typhoon 8 takes laser printing to incredible new heights.

**Leave your network printing problems behind.**

The Typhoon 8's patented Virtual Printer Technology (VPT™)

handles multiple protocols and provides custom settings for up to 64 users on your network!



**So get up to speed.**

At \$5,199, we've broken the price barrier to the next level of printing.

Call today and ask about our free PostScript fax/modem offer  
**1-800-980-0374**

 **Dataproducts**  
*Taking your printing needs by storm*

© 1995 Dataproducts Corporation. Dataproducts and Dataproducts with its associated logomark are registered trademarks and Typhoon and VPT are trademarks of Dataproducts Corp. PostScript is a registered trademark of Adobe Systems Inc.

**Circle 220 on Inquiry Card (RESELLERS: 221).**



based on the computational difficulty of finding the prime factors (the "keys" to the code) of very large numbers.

Because the U.S. does not allow cryptographic hardware and software to be exported—even when, as here, the essence of the algorithm is mathematical theory that anyone can learn—Zimmerman has had a number of encounters with police types since PGP's debut in 1990. It seems strange that a democratic government would find itself

among those opposing privacy, but computers make strange bedfellows.

## ■ Uncrackable Code Cracker

In 1977, Ronald Rivest, Adi Shamir, and Leonard Adleman (the RSA of RSA public-key encryption) created a short message with their code and challenged all comers to crack it. Arjen K. Lenstra, a scientist at Bellcore (Bell Communications Research), took up the gauntlet in 1993 and in May 1994



# Can Your UPS Do This?



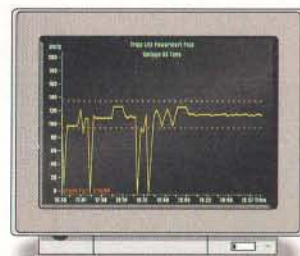
## Smart Series Exclusive #1

PowerAlert Plus software allows you to view operating information on any network station from any network station.



## Smart Series Exclusive #2

PowerAlert Plus records all power problems networkwide to one easy-to-view Master Log.



## Smart Series Exclusive #3

PowerAlert Plus' built-in graphing utility allows you to graph incoming power anywhere on the network.

# FIND OUT MORE

Call now and we'll send you our **FREE VIDEO** or your no-obligation sample unit. 312/755-8741 Ask for Dept. Q30



280 VA to 5000 VA models available



500 N. Orleans  
Chicago, IL 60610  
Tel: 312/755-8741  
Fax: 312/644-6505



**The Smart Series UPS from Tripp Lite**  
**The Power Protection Price Leader**

announced that RSA-129 (so-called because its public key is 129 digits—429 bits—long) had been cracked. RSA had to pony up \$100, the reward offered for the feat.

The eight-month effort was no mere computer program. The complexity of finding the prime factors of large numbers required the organization of a "metacomputer": a loose confederation of many computers, each working on a piece of the problem. This particular project involved the spare execution cycles of some 1600 PCs and workstations and 600 teammates scattered along the Internet all over the country.

Not to worry about possible threats to security as a result of this particular code-cracking. First it's unlikely that such eight-month/1600-computer projects would go unnoticed. And second, actual real-life encryption uses keys 512 to 1024—or more—bits long. A 1024-bit RSA key would require  $3 \times 10^{11}$  MIPS-years to crack.

So, what did the decoded message say? "The magic words are squeamish ossifrage." Shouda guessed.

## Hi, Liz, Guess Who?

In 1994, an unknown temporary worker at British Telecom used his boss's passwords, conveniently taped to the side of his computer monitor, to ferret out the secret not-published-in-any-directory phone numbers of Her Royal Majesty the queen, Prime Minister John Major, and several top-secret MI5 installations, among others. Freelance Scottish journalist Steve Fleming saw a scoop and sold the tale to *The Independent*. In the meantime, the list of phone numbers was also posted on the Internet before it was yanked by investigating officials. Then, the unknown temp turned out to be—Steve Fleming. No one knows how many unexpected phone calls Her Majesty has had to field.



# Visual Multimedia Without Writing One Line of Code

Now you can with MediaWorks. MediaWorks is a totally code free Windows-based multimedia authoring tool. Create computer-based

easy to learn and offers an extensive online help system, tutorials and sample applications. Receive unlimited FREE technical support on Compu-

training programs, interactive presentations, kiosks, electronic catalogs, special interactive encyclopedias, reference systems, electronic newsletters, CD-ROM titles and hundreds of other interactive applications. This was once only achievable by writing lines of complicated code. Now MediaWorks allows you to create your own

Serve or via the Internet. For those major applications our consulting services division is available to guide you on every step of the way and provide innovative custom programming solutions. Find out why MediaWorks won

first prize as Best Multimedia Product 1995 by IDG Communications in Europe. MediaWorks is Windows 95 ready and requires a minimum of a 486SX system with 4MB of RAM, CD-ROM drive and a Super VGA monitor.



**\$ 295**

**Call 1-800-544-9116**

To Order 24-hours-a-day or for Free Literature



Circle 283 on Inquiry Card.

**MediaWorks®**

by *Instinct®*  
CRESCENDO MULTIMEDIA

USA/Canada: 412-831-1649 fax 412-831-0443

Worldwide: +396-37.21.790 fax +396-37.21.954

Internet USA/Canada: InstinctUS@aol.com

Internet Worldwide: Instinct@msn.com

MediaWorks offers hundreds of special effects, graphical backgrounds and multimedia clips to enliven your application or you can import your own special effects from other Windows applications. MediaWorks supports the following file formats: BMP, PCX, JPEG, TIF, GIF, FIF, CMP, WMF, WPG, Kodak PhotoCD, ANI, AVI, FLI/FLC MOV, MPEG, WAV, MID, CDA, and MMM. MediaWorks features total OLE integration and royalty-free run time distribution.

Prices do not include shipping and handling. Canadian orders are subject to surcharge.

\* Proper proof of purchase required for the competitive upgrade price. Qualifying products include: Director ToolBook, MediaBlitz, Power-Point, WP Presentations, Freelance, Compel, Authorware, NeoBook, StoryBoard

MediaWorks is a registered trademark of Instinct. All rights reserved worldwide. Windows is a registered trademark of Microsoft Corp. All other names are trademarks of their respective owners.

**F R E E D O M T O C R E A T E I N M U L T I M E D I A**





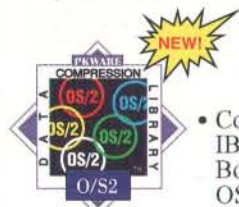
# PKWARE®

## Data Compression Library® Products

The PKWARE Data Compression Library products allow you to include state-of-the-art, patented data compression technology within your software applications. Data produced by the PKWARE Data Compression Library products is compatible across platforms!

The PKWARE Data Compression Library products offer an all purpose data compression algorithm which compresses ASCII or binary data quickly. An adjustable dictionary size allows software to be fine tuned for maximum speed or compression efficiency. The use of application defined callback functions allow maximum flexibility. No runtime royalties. The format used by the compression routine is completely generic and not related to the PKZIP® file format.

Versions available for DOS, OS/2, Windows, Win32 (separate versions for Alpha, Intel, & Power PC), DOS32 and UNIX (call for systems supported)!



- Compatible with IBM Cset/2 & Borland C++ for OS/2.

- Routines provided as an object file & library file.
- Requires 36k of memory to compress & 12.5k of memory to extract.

OS/2 Version **\$350**



- Compatible with Microsoft Windows 3.x applications.

- Fully reentrant.
- The DLL requires 36k of memory to compress & 12.5k of memory to extract.

Windows Version **\$350**



- Supports both Intel & Alpha object modules.

- Compatible with Microsoft Visual C 32-bit & Borland C++.
- Requires 36k of memory to compress & 12.5k of memory to extract.

Win32 Version **\$375**



- Compatible with popular 16-bit language compilers.

- Can be used in any memory model.
- Requires 35k of memory to compress & 12.5k of memory to extract.

DOS Version **\$275**

**PKWARE® INC.**  
The Data Compression Experts.

9025 N. Deerwood Drive  
Brown Deer, WI 53223-2437  
Phone: (414)354-8699 Fax: (414)354-8559  
PKWARE, INC. WEB SITE # <http://www.pkware.com>

Please add \$5.00 Shipping & Handling per package in the U.S. & Canada; \$11.25 overseas. Wisconsin residents please add 5% state sales tax & applicable county sales tax. No COD.



Copyright 1994, PKWARE, Inc. PKWARE, the PKWARE logo, PKZIP, and the PKWARE Data Compression Library are registered trademarks of PKWARE, Inc. Microsoft is a registered trademark and Windows, Win32, and the Windows logo are trademarks of Microsoft Corporation. OS/2 and the OS/2 logo are registered trademarks of International Business Machines Corporation. Trademarks of other companies mentioned here appear for identification purposes only and are the property of their respective companies.

### ■ The Joy of Ex

The many achievements of Sun Microsystems cofounder Bill Joy are legendary, and anyone would garner Joy a bust in the Unix wing of the Hacker Hall of Fame (to be constructed). In 1975, Joy became a Ph.D. student at UC Berkeley. Captivated by Unix, but unhappy with the ed line editor, he took the code for the em ("editor for mortals") editor (supplied by developer George Coulouris) and in a week produced most of the ex editor. In 1976, Joy wrote an improved Pascal compiler for Unix that became a standard Pascal programming tool. In 1978, he produced the first BSD (Berkeley Software Distribution) of utilities and began distributing BSD on tape. That same year, he created the vi editor and distributed the 2BSD (Second Berkeley Software Distribution). The 3BSD was a complete bootable system. In the early 1980s, Joy took the nascent TCP/IP and in a few weeks was running it satisfactorily between test machines. In one night, he wrote the utilities rcp, rlogin, and rsh for temporary use: They're still going. Joy also created the C shell for BSD, and it was subsequently adopted in AT&T's own Unix System V release 4.0. No one person has done for Unix what Joy has.

### ■ Legion of Doomed

The self-styled LOD (Legion of Doom) was basically a bunch of fun-loving guys (fun here having the special meaning *seizing control of telephone lines and switching equipment, eavesdropping on private phone conversations, unauthorized logging on to phone company computers, messing up telephone billing information, and helping others to do the same*). Naturally, the pursuit of such a unique variety of fun requires some pretty specialized know-how, such as BellSouth's internal technical specifications for the 911 emergency telephone network. In 1990, the boys from LOD's Georgia franchise managed to overcome their ingrained bourgeois notions of personal property, purloined a copy, and were caught. The value of the document in question ranged from \$20 to \$24,639 to \$70,000, with value definitely being in the eye of the beholder. BellSouth also maintained that the LODsters had lifted log-ins, passwords, and connect addresses with a value of \$233,800 and that it had spent \$1.5 million in fingering them and a further \$3 million defending the company

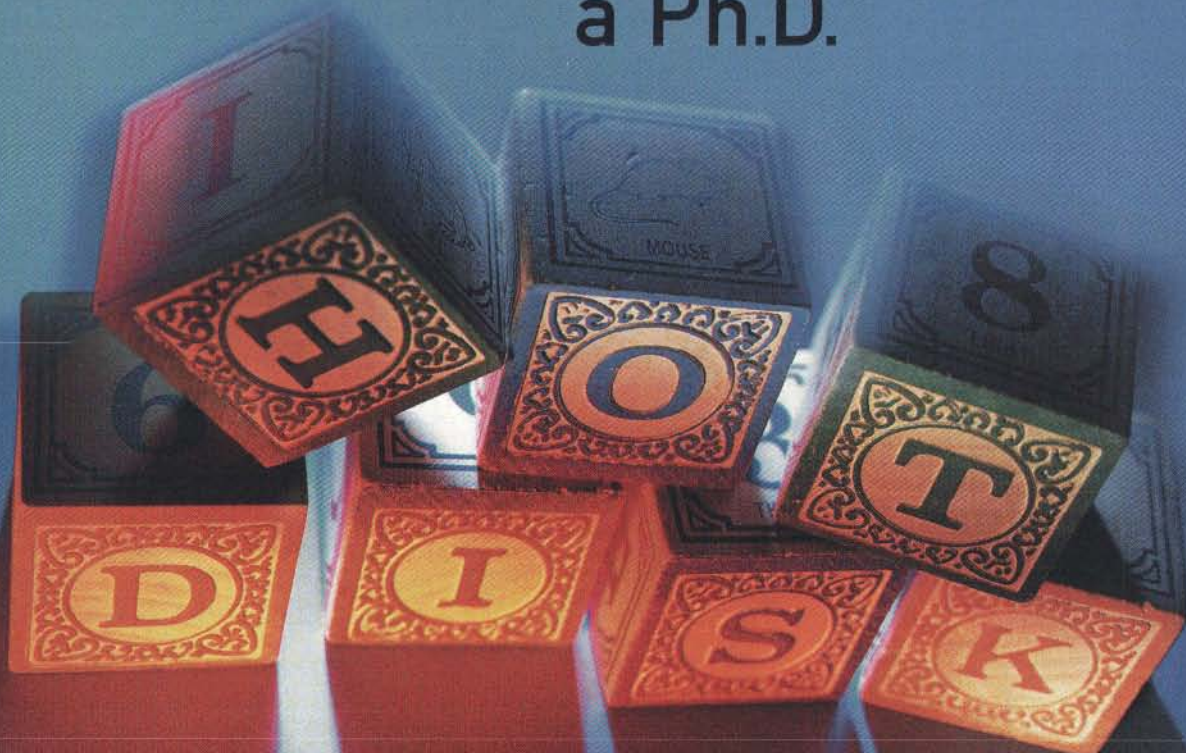
BY995





DOS  
COMPATIBLE

# Now you can ACCESS FILES on another PC WITHOUT a Ph.D.



If all you want to do is get files from your desktop to your laptop, you shouldn't have to go through college to do it. Which is exactly why we made HotDisk® a no-brainer.

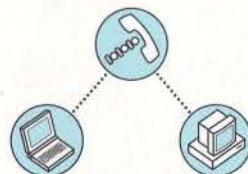
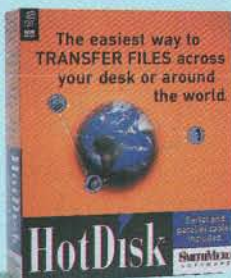
If you can press "Enter" you can install HotDisk. Once it's set up, double-clicking on the HotDisk icon connects you — either modem-to-modem or port-to-port — with up to 10 drives on or available to another computer.

These drives appear exactly as they would if they were on your own computer. And you can do anything with them you can do with your own drives — as well as swap or synchronize files, directories or even entire disks.

Since you're using the programs you have with you, it's a lot faster than remote control. And because HotDisk operates silently in the background, someone can still use the other computer.

So call Smith Micro at **800.964.SMSI\*** or visit your nearest computer superstore today to get HotDisk. It comes complete with software and both serial and parallel cables.

After that, accessing data from another computer will be mere child's play.



Now anyone  
can transfer files by  
modem or cable.

**SMITHMICRO**  
SOFTWARE

\*Or 714.362.2345. HotDisk is available now at CompUSA, Computer City, Micro Center, Egghead Software and elsewhere. HotDisk is a registered trademark of Smith Micro Software, Inc. All other product names are trademarks or registered trademarks of their respective companies. ©1995 Smith Micro Software, Inc.

**Circle 266 on Inquiry Card (RESELLERS: 267).**



from them. Convicted defendants Franklin E. Darden, Jr., Adam E. Grant, and Robert J. Riggs were given sentences of 14 months, 14 months, and 21 months, respectively, and ordered to pay restitution of \$233,000 to BellSouth. Life isn't always fair.

## ■ Nerdz n the Hood

In contrast to the LOD (characterized by some as well-off white guys), the

MOD (Masters of Deception, whose initials were deliberately chosen to be one up on LOD) was a posse of multiethnic teenagers mainly in working-class Brooklyn and Queens. Their definition of fun was eerily similar, however, perhaps a tribute to the social empowerment possible with computers. This gang was adept at invading the systems and networks of powerful entities, including AT&T, Bank of America, TRW,

and the National Security Agency, displaying a mastery of telephone, network, Unix, and VAX arcana to rival the experts in the invadees mentioned but using only the most basic equipment (like a Commodore 64). Besides the usual telephone-torturing shenanigans, the MODers could also access and circulate supposedly private credit reports. The MODs and the LODs were constantly staging skirmishes against each other, mainly in the form of bizarre phone pranks that caused great collateral damage to the phone service of innocent bystanders.

In 1991, investigators from a number of agencies, including New York Telephone's investigative unit, the FBI, and the Secret Service, used the first wiretaps ever in a hacker case to unmask the MODs. Members included Messrs. Mark Abene (Phiber Optik), Julio Fernandez (Outlaw), Eli Ladopoulos (Acid Phreak), John Lee (Corrupt), and Paul Stira (Scorpion). In 1993, Abene received a one-year sentence, while Ladopoulos and Stira each received six-month sentences, plus probation and community service time. Because they were teenagers at the time of the acts for which they were convicted, and because their subsequent behavior has been good, observers expressed regret at the sentences.

## ■ MacPuzzle

Besides everything else he did to help get the first Macintosh out the door, Andy Hertzfeld wrote all the first desk accessories. Most of these were written in assembly. However, to show that desk accessories could also be written in higher-level languages, Hertzfeld wrote a demonstration puzzle game desk accessory in Pascal. Like its plastic counterparts, users moved squares around until the numbers 1 to 9 were in order. As time began to get short, the decision was made that the puzzle, at 7 KB, was too big (and too game-like) to ship with the first Macintosh. In a single weekend, Hertzfeld rewrote the program to take up only 800 bytes. The puzzle shipped with the Mac.

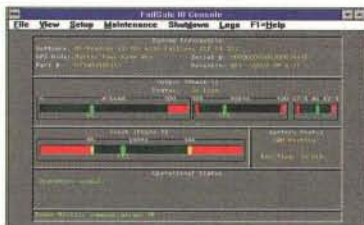
## ■ Software Immortality

Quick, look at the beginning of any EXE program that runs on DOS, Windows, NT, or OS/2. Although you may never have noticed it before, they all start with the two ASCII characters MZ. Why MZ? Those are

# Just Protect It!

With list prices starting at just \$139, protecting your PCs or LANs against faulty power has never been easier or more affordable. Combine this with our unmatched product quality, service, and Exclusive 5- and 10-Year Triple Power Warranties™ — you're guaranteed unsurpassed UPS protection.

And with our state-of-the-art Power Management Software, you can leave for lunch knowing that, if a power problem strikes, your system and data will be saved and fully protected — *automatically!*



The PowerRite Pro and Plus UPS families incorporate Deltec's proprietary Advanced Battery Management (ABM™) that doubles battery life and assures system uptime!

Deltec's FailSafe and LanSafe III software automatically save your files and conduct an orderly system shutdown during extended blackouts — even in unattended modes — along with extensive monitoring and power management when used with our microprocessor-based UPSs.



Don't let yourself become powerless. Call now for our "Quick Fax Power Guide" and immediately receive a FREE assessment of your computer power needs.



**Call Now!**

**1-800-DELTEC-1**



**DELTEC-NSSI**  
A Fiskars Company  
**Innovators in Power Protection**

**Don't Risk It — Just Protect It!**



Compaq,  
IBM, Dell,  
and Toshiba  
do **not** offer



*"If you're looking for a lot of computer in a small box, look no further than Tadpole's SPARCbook..."*

BYTE Magazine, June 1995

*"This is the creme de la creme of power notebooks."*

INFOWORLD, June 5, 1995

## Tadpole Technology Does.

ultra-high  
performance  
notebooks.

None of the other guys do. In fact, there's only one company that offers 32-bit, ultra-high notebook performance in either a SPARC™ or Pentium™ platform...Tadpole Technology.

### Powerful Pentium Performance

Tadpole's family of Pentium notebooks is the fastest on the planet. The newest member, the Tadpole P1300, features 133MHz performance and PCI bus, a Lexmark keyboard, 1MB video RAM, and an 800 x 600 SVGA 10.4" TFT screen.

### Watch Our SPARCbooks Fly

Tadpole's family of microSPARC II notebooks delivers UNIX workstation performance, high portability, plus Solaris and Windows compatibility. Tadpole's 110MHz SPARCbook 3GX features 2MB of video RAM, a Weitek P9100 graphics accelerator for fast screen redraws, and an 800 x 600 SVGA 10.4" TFT screen.

### Performance Today... And Tomorrow

Tadpole's family of notebooks features modular architecture that can be configured to match your changing needs. You can get memory upgrades to 128MB, a removable 2.5" hard drive with up to 1.2GB capacity and two PCMCIA slots. And to protect your investment, Tadpole surrounds the inside with a lightweight, rock-hard magnesium case. These are the last notebooks you'll ever need to buy!

### The Right Move For Those On The Move

Our family of Pentium and microSPARC II notebooks isn't for everyone. But if you're someone who demands ultra-high performance, compatibility, connectivity, and durability in a notebook, Tadpole Technology has your number. The next move is yours. Call **1-800-232-6656** today.



United States: 512 219 2200  
United Kingdom: 01223 428200  
France: 1 60 86 27 92  
Germany: 49 9129 2859 70  
World Wide Web: <http://www.tadpole.com>



SPARCbook is a registered trademark of SPARC International, licensed exclusively to Tadpole Technology. Pentium is a registered trademark of Intel Corporation. Windows and Windows NT are registered trademarks of Microsoft Corporation. All other trademarks belong to their respective companies. © 1995, Tadpole Technology.

Circle 256 on Inquiry Card (RESELLERS: 257).



# Hacks, Cracks, Phreaks, and Feats

HACKERS ARE  
THE "GOOD GUYS,"  
CREATING REMARKABLE  
SOFTWARE IN  
RECORD TIME.  
CRACKERS ARE  
HACKERS GONE BAD.

the initials of Microsoft programmer Mark Zbikowski, who has thereby achieved a kind of immortality (as long as people are running DOS-compatible programs).

## ■ Pirates, Ho!

Using the computer system at Florida State University as a stepping-stone to the Internet, software pirates in 1994 illegally uploaded IBM's OS/2, Microsoft Windows 95 beta, and other commercial programs to an area where anyone on the Internet could snag them for nothing. As a result, the Windows 95 beta is currently one of the most pirated and most posted programs on the Internet.

## ■ Gotta Finder

It sounds like a strange adventure game. You have six months until your company ships its revolutionary new computer and millions of people will turn it on and see—what? Well, that was the problem haunting Steve Capps and Bruce Horn in the summer of 1983. With the Mac's announcement scheduled for January 1984, they had to code what would come to be known as the Mac Finder—the file-manipulation and ap-

plication interface that "knowledge workers" would be looking at and using day in and day out. Despite what you've heard about Apple simply lifting the Xerox Star's interface, every detail of the Mac's interface was discussed, experimented with, and agonized over for months. Some aspects were inherited from Apple's failing Lisa. Steve Jobs offered suggestions and vetoes. Designer Susan Kare took care of the aesthetics. The result was an interface people still point to as the way to do it right. And it ran in 50 KB.

## ■ A1 Effort

In 1978, Harvard Business School graduate student Dan Bricklin had an idea for a kind of electronic blackboard that would automatically do calculations. His "visible calculator" became VisiCalc a year later, developed with Bob Frankston and published by Personal Software. The first electronic spreadsheet, VisiCalc appeared first for the Apple II computer—its 32-KB total size fitting comfortably into the Apple II's maximum of 48 KB of memory. Every spreadsheet since has duplicated features that VisiCalc premiered: automatic recalculation, labeled rows and columns, built-in math and business functions, and the ability to change parameters to do what-if analysis. Its under-200-page manual is in marked contrast to the multivolume bricks for today's spreadsheets.

## ■ St. Paul, Oscar Wilde, and...

In 1979, while hoosegowed in Pennsylvania's Northampton State Prison for offenses of the phone-phreaking kind, John Draper (aka Cap'n Crunch, after a brand of cereal whose free toy whistle's pitch could switch phone lines so phreaking might begin) wrote the word processing program Easy Writer on a computer provided as part of his rehabilitation program.

## ■ Rebel Without a Clue

Bulgaria's otherwise-unknown Dark Avenger creates and unleashes a plethora of computer viruses all over the world. He has also produced a virus-making toolkit to make it easier for like-minded misanthropes to foul up the computers of total strangers. Romantic enough to name a virus after the American virus researcher Sara Gordon, who reputedly interviewed him, his main satisfaction seems to come from

causing misery to millions of computer users the world over. What's he avenging? Who knows?

## ■ Hackers in Space

NASA astronaut Richard J. Hieb assisted in the dramatic rescue of the off-course \$150 million Intelsat IV satellite in May 1992. Maneuvering the space shuttle (Endeavour, in this case) to rendezvous with another object in space is a surprisingly complex chore, rendered more difficult by traditional radar technology's inability to accurately measure the distance and relative speed of objects that get that close and move that slowly relative to each other. Luckily, on this rescue mission, they were employing a new laser-assisted system with software written by Hieb himself.

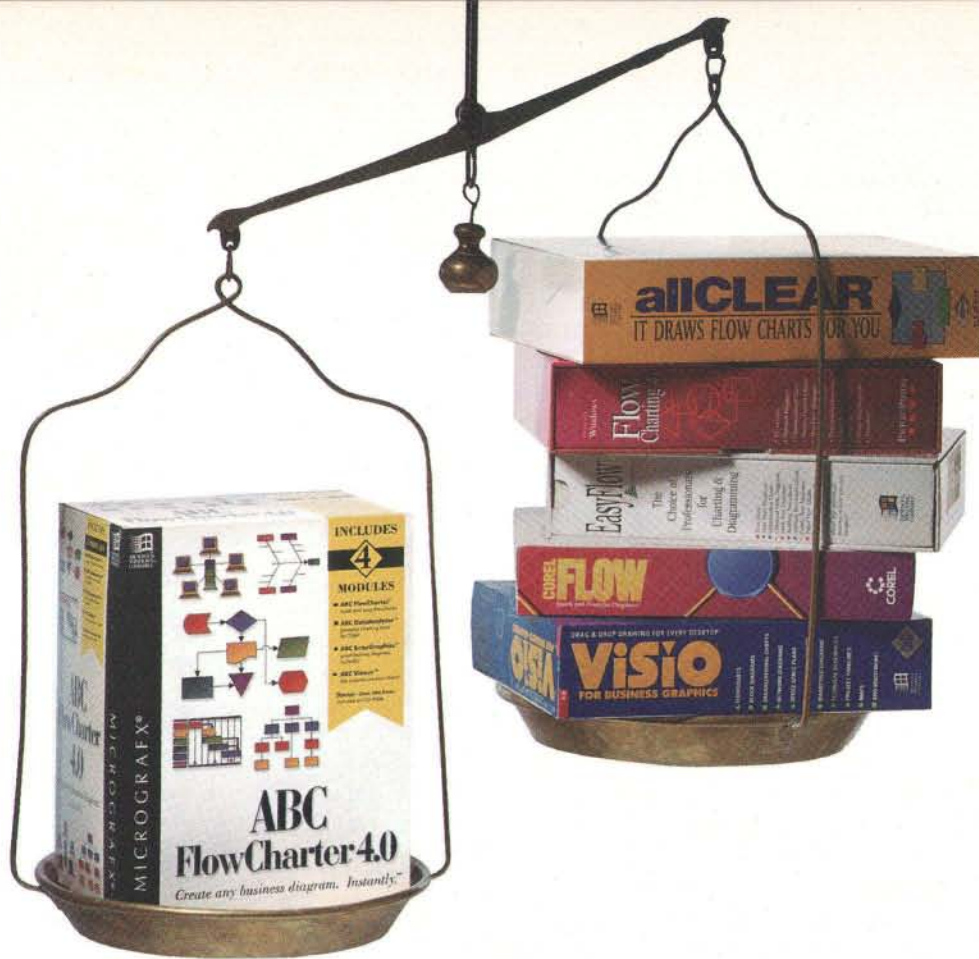
Hieb began writing his Payload Bay program (in C) in the early 1980s on his home computer. When he actually used it, he was quite far from home, running Payload Bay on one of NASA's Grid laptops. The OS? Plain old down-to-earth DOS.

## ■ Dial H for Hacker

When a Chicago-area real estate company started having trouble with its telephone voice-mail system in 1989, it had unwittingly exposed the tip of a nationwide criminal iceberg. Intruders were breaking into voice-mail systems, creating their own voice-mail accounts with which to barter stolen credit card numbers, changing passwords to lock out the legitimate users and administrators, and then using the systems to dial out again—toll free. They would use the stolen credit card numbers to buy Western Union money orders that their leader eventually turned into cash, kicking back a percentage to over 150 accomplices nationwide. They would also crack corporate PBX codes, enabling them to make







# Introducing ABC FlowCharter 4.0. The reigning business graphics heavyweight.

When it comes to creating high-quality business diagrams, new ABC FlowCharter 4.0 gives you ultimate power, flexibility and control. The program

is loaded with four fully-integrated modules specifically designed to meet the demands of the business graphics user. Whether you need to create complex flowcharts for TQM and BPR, analyze your statistical data, or

simply pull together clean, colorful presentation charts in a matter of minutes, ABC FlowCharter 4.0 can help you accomplish your mission. Only ABC FlowCharter 4.0 fea-

tures automatic line crossovers, intelligent line routing and data fields. And those are just a few of the features we've

added to make your life easier.

Right now you can get ABC Flowcharter 4.0 for as little as \$99.95 upgrade. And you can upgrade from any business graphics program you already own. No other program gives you such complete power for so

FEATURES	ABC FlowCharter	Visio 3.0	CorelFLOW2.0
Intelligent line routing	★		
Automatic add/delete shapes	★		
Automatic line crossovers	★		
Data fields	★		
OLE 2.0 automation	★	★	
Royalty free flowchart viewer (ABC Viewer™)	★		
Statistical Process Control Charting (ABC DataAnalyzer™)	★		
21 pre-defined diagram templates (ABC SnapGraphics™)	★		

little. If you want to settle for less, it's your business. Contact your favorite reseller or call 1-800-877-3040.

**\$99.95**  
UPGRADE\*



## MICROGRAFX®

Circle 227 on Inquiry Card (RESELLERS: 228).

\*U.S. SRP (\$149.95 Canadian) for users of any Micrografx product or any version of the following competitive products: Visio, CorelFlow, AllClear, Flowcharting 4, EasyFlow, or other diagramming software. Copyright 1995© Micrografx Inc. All rights reserved. All trademarks are owned by their respective companies.





unlimited, free long-distance calls. Hundreds of long-distance calls for hundreds of thousands of dollars were billed to the helpless voice-mail and PBX owners. The criminal ring stole over \$9000 in charged merchandise, \$1000 in money orders, \$30,000 in voice-mail service, \$250,000 in telephone service, and \$1.2 million in PBX long-distance telephone service.

Who was the apparent mastermind of this scheme? Agents found over 150 telephone credit card numbers, over 250 bank credit card numbers, and dozens of PBX "extender" codes in the possession of a 35-year-old Chicago mother of two, Leslie Lynn Doucette (Kyrie). She was sentenced to a 27-month prison term in 1990.

## ■ The Wizard of Woz

Steve Wozniak began designing a computer partly because he didn't have enough money to buy one. The results were the Apple I and Apple II computers. Wozniak also

wanted to build the kind of computer he wanted to use. At the time, many computers relied on cassette tapes to save and distribute programs and data. Wozniak designed a 5¼-inch disk drive system for the Apple II, reckoning—correctly—that disks would become a tad more popular than cassettes. Unlike other disk drive systems—IBM's comes to mind—that were based on a conglomeration of electronics and mechanical components, Wozniak's system was based completely on software control of the drive. As a result, Apple II drives had the flexibility to read and format a variety of disks—hard-sectored, soft-sectored, or whatever—without hard-wired preset settings. The software implementation also meant that expensive and complex interface boards were not necessary, making the Apple drives simpler and cheaper.

The Apple II had rudimentary sound but composite video and a simple and compact layout. Wozniak made sure the Apple II had expansion slots in the motherboard to

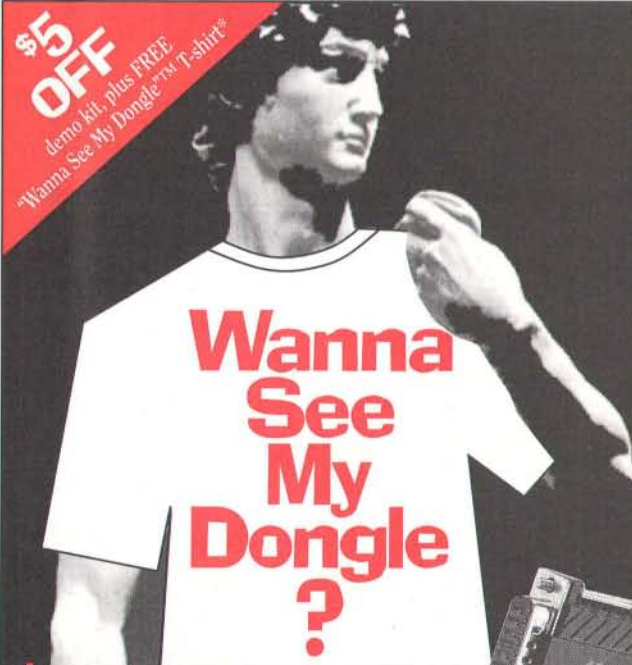
**4**  
YEARS  
AGO IN  
**BYTE**



**BYTE starts a new series of "language survivors." First up: FORTRAN.**

**Haitian President Jean-Bertrand Aristide and his democratic government are deposed in a military coup.**

allow simpler upgrading (like Microsoft's CP/M emulation board to run WordStar), a feature IBM later included in the first IBM PC. Wozniak also became a master of the MOS Technology 6502 chip, not because it was a more capable microprocessor than Motorola's 6800 or Intel's 8080, but because it was cheaper—an important consideration whenever starting a multibillion-dollar industry from a garage.



**\$5 OFF**  
demo kit, plus FREE  
"Wanna See My Dongle"™ T-shirt\*

**1-800-MARX-INT**


**Wanna See My Dongle?**

Just because you've seen one dongle doesn't mean you've seen them all! The Marx CRYPTO-BOX is the most sophisticated and effective protection against software piracy and unauthorized duplication you can buy! \*Call toll free to order a demo kit at \$5 off the regular \$19.95 (plus S&H) & a FREE "Wanna See My Dongle" T-shirt with every order while supplies last.

Box 95743, Atlanta, GA 30347 Germany: 8403-1555 France: 8881-4031

**MARX INTERNATIONAL, INC.**

Circle 281 on Inquiry Card.



## The Port Authority.

The Sealevel fleet has expanded to over 75 communication and I/O products for the PC and compatibles. And each remains true to our original course: to provide you the value of high end features and reliability at low end prices.

**Versatile Vessels** - Sealevel products provide selectable addressing and flexible interrupt request selections. 16550 UART's are standard while optional 16650 enhanced UART's are available to provide compatibility with twice the buffer size.

**Chartered Voyages** - We're one of the few that encourages you to captain our resources to design and build customized products to fit your specific needs.

**Lifeline** - We provide comprehensive technical support staffed with knowledgeable people who can navigate you through even the roughest water.

**Whatever Floats Your Boat** - We offer a wide variety of communication and I/O cards for multiple platforms including ISA Bus, PC/104, PCMCIA, and Micro Channel.

**Products Include:** Multi-port DOS, Windows, and OS/2. Serial I/O • High-speed Sync/Asyn • Digital/Latching Relay I/O • Solid State Disk Emulation Systems

**Electrical Interfaces Supported:** RS-232, RS-530, RS-422/485, RS-449, 20mA Current Loop, V.35, and more.

For more information, call 803.843.4343.

PO Box 830  
Liberty, SC 29657  
Tel: 803.843.4343 • Fax: 803.843.3067

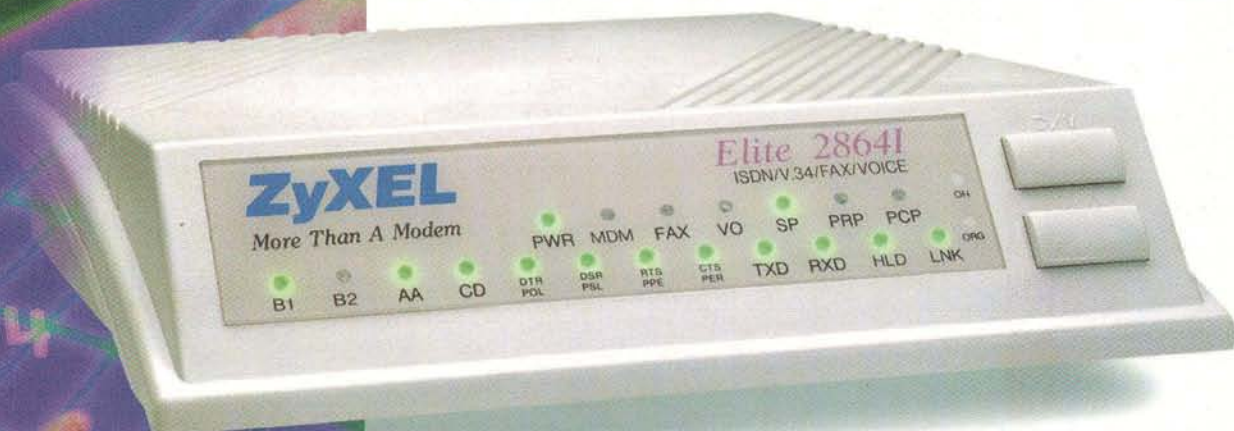
Visa and MasterCard accepted.  
All brand and product names mentioned are trademarks or registered trademarks of their respective holders.

Circle 244 on Inquiry Card (RESELLERS: 245).



INTRODUCING ISDN WITH V.34 IN A SINGLE DEVICE

# THE MODEM OF THE MILLENNIUM



Blazing ISDN speeds up to 128Kbps and analog speeds up to 28.8Kbps. Implement V.42bis on ISDN for even higher performance capability. You get it all in one device with the new ZyXEL digital modem, the Elite 2864I— giving you the best of the digital and analog worlds.

The Elite 2864I is an ISDN device that also works like a modem, automatically switching between digital and analog devices without user intervention, while maintaining the highest possible speed and transmission integrity:

- Supports all popular switches. Rate adaption: ITU-T V.120, V.110 and X.75 SLP
- Two B channels can be bundled for ultra-high 128Kbps or used for two simultaneous connections, e.g., voice and data
- Built-in analog adapter communicates with all analog devices
- V.42bis compression on ISDN achieves higher throughput for greater performance
- Embedded protocol analyzer
- Data encryption (DES)\*
- Supports V.34 and is backward-compatible
- DTE serial interface up to 460.8Kbps
- High-speed fax — V.17 (14.4Kbps) send and receive. Supports G3 EIA Class 1, 2 and 2.0
- Parallel port for direct fax printing

Don't settle for less than the unique engineering design of the ZyXEL digital Modem of the Millennium.

**Call your ZyXEL dealer or call 800-255-4101.**

Circle 258 on Inquiry Card (RESELLERS: 259).

## ZyXEL

THE MODEM OF THE MILLENNIUM

4920 E. La Palma Avenue, Anaheim, CA 92807 • Telephone: (714) 693-0808 Fax: (714) 693-8811  
BBS: (714) 693-0762 • Internet: sales@zyxel.com • URL: <http://www.zyxel.com>

\*ZyXEL does not assume any liability arising out of the application or use of any of the security functions described herein. Neither does it convey any license under its parent rights nor the rights of others. Specifications are subject to change without notice. All trademarks are the property of their respective owners.

Model	Description (5-year warranty)
Elite 2864I-U	LED, ISDN (U interface)
Elite 2864I-S/T	LED, ISDN (S/T interface)
Elite 2864	LED, 2 wire dial-up/leased line
Elite 2864L	LED, 2 wire dial-up, 2/4 wire leased line





# GO OBJECTS!

## Attend OBJECT WORLD FRANKFURT, October 9-11, 1995 THE SOFTWARE EVENT FOR CENTRAL EUROPE

Would you like to learn how industry leaders in aerospace, CASE, financial services, healthcare, manufacturing, multimedia and telecommunications are using object technology (OT) to solve real-world problems? Or find out how to use OT to create distributed applications? Or boost your OT IQ?

Then sign up for Object World Frankfurt, October 9-11, at the Sheraton Conference Center(Airport), Frankfurt/Main, Germany.

- Gain a world of knowledge at the Object World Frankfurt Conference!
- See new products in action
- Don't Miss Our FREE Keynote Sessions
- Learn all about CORBA. 1995, The Year CORBA 2 goes into production
- Attend the Object Application Awards Ceremony (co-sponsored by BYTE)

**Object World, the largest all-Object Technology event worldwide**

Register now. Sign up for Object World Frankfurt by September 10 and get a FREE Exhibits Pass. Or save DM 500,- on the full conference program. Return this coupon to: LogOn Technology Transfer, Frankfurter Str. 15, D-61476 Kronberg (Ts.), Germany. Or Fax it to +49-6173- 94 04 20. Any questions? Call us at +49-6173-2852.

Check one:

- ☐ **YES!** Reserve-without obligation-my DM 500,- discount on the full conference program at Object World Frankfurt'95 Conference and Exhibition.
- ☐ **YES!** I am interested in the Object World Frankfurt Conference. Please send me a detailed conference brochure.  
(Brochure will be mailed approximately 12 weeks prior to the conference.)
- ☐ **YES!** I want to sign up for my FREE Exhibits Pass - a DM 30,- value.
- ☐ I am not ready to register at this time. Please send me more information about: ☐ Attending ☐ Exhibiting at Object World Frankfurt

First Name

Last Name

Company Name

Title

Address

City

State

Zip Code

Country

Telephone

Fax

E-mail

Circle 553 on Inquiry Card.

Sponsored and produced by: Object Management Group (OMG), IDG WEC, LogOn Technology Transfer. Main sponsor: **IBM**

### Conference

You can choose from a total of 12 tutorials and over 50

- conference sessions organized into four separate tracks:
- Management
- Object Infrastructures
- Software Development
- Applications & Business Solutions

### FREE Keynote Sessions

What is the Impact of Object Technology for the Enterprise?

Brian Croll, Director, SunSoft; Franz Joseph Fritz, Head Business Division, SAP; Mark Ryland, Manager, Microsoft; John Slitz, Vice President OT, IBM; Chris Stone, President & CEO, OMG

### Multimedia Objects

Dennis Tschritzis, Chairman of the Executive Board, GMD

### Putting Objects To Work on a Massive Scale:

Migrating One of the World's Largest Telecoms to Distributed Object Computing. Michael Brodie, Senior Scientist, GTE

### Exhibit floor

Visit the Object World exhibit floor and get a firsthand look at the new products and development in object technology from over 70 leading vendors. Exhibitors who already confirmed or option participation to Object World Frankfurt '95 include (As of March 29, 1995):

BYTE Magazine- MacGraw Hill  
Cincom Systems  
Cutter Publications  
CompuTec Software  
Diamond Software  
Digital Equipment  
Easel Deutschland  
Georg Heeg Objektorientierte Systeme  
Goodstep  
Hewlett Packard  
IBL Ingenieurbüro  
IBM Deutschland Informationssysteme  
IOSoftware  
IQProducts  
JF Lehmanns Fachbuchhandlung  
KISS Kristen Informatic & Software Services  
Miccado Software Consult  
MICRAM Object Technology  
microTOOL  
Nexus  
Object Management Group (OMG)  
O2 Technology  
Objectivity Inc.  
run Software-Werkstatt  
Siemens Nixdorf  
Scientific Computers  
Softlab  
Software AG  
Sybase  
Sun Microsystems  
SunSoft  
TakeFive Software

### The 2nd Object Application Awards Program

After the great success of last year, Object World Frankfurt will present again the Object Application Awards Program. The Program is designed to publicize the best custom applications using OT. The Awards will be granted to five winners selected from 15 finalists. Winners will be announced at an award ceremony, open to all attendees. The Awards Program is co-sponsored by BYTE Magazine, the Object Management Group and LogOn Technology Transfer.





# Famous Vaporware Products

## ■ Xanadu

*Ted Nelson*

Nelson first conceived his futuristic vision for hypertext way back in 1960; although his idea inspired countless products, Xanadu is still pending. Autodesk worked on it from 1988 to 1992; Nelson later hooked up with Japan's Sapporo HyperLab.

## ■ Ovation

*Ovation Technologies*

The term *vaporware* was first coined to describe this integrated software package for DOS. Announced in 1983, it never shipped. That was 12 years ago.

## ■ Windows 1.0

*Microsoft*

"Microsoft Does Windows!" gushed InfoWorld in 1983. Perhaps, but not for two more years.

## ■ Macintosh Office

*Apple Computer*

Steve Jobs's infamous "reality distortion field" was running in overdrive when he announced this networking solution in 1985. It didn't become real until 1987.

## ■ 1-2-3/G

*Lotus Development*

The first graphical version of Lotus 1-2-3 (for OS/2) was announced in April 1987 but wasn't delivered until September 1990.

## ■ Wingz for Windows

*Informix*

Neat new tote bags at every Comdex. But until 1990, they were empty.

## ■ 1-2-3 for Macintosh

*Lotus Development*

Mac users had been waiting more than four

years when 1-2-3 finally shipped in 1991. Unfortunately for Lotus, most of them decided it wasn't worth the wait.

## ■ Windows NT

*Microsoft*

In 1991, it was known as OS/2 3.0 or OS/2 NT. Then IBM and Microsoft had a little spat. When NT arrived in 1993, it was Windows all the way.

## ■ dBase for Windows

*Borland International*

Impatient dBase users tapped their toes for nearly five years. Many had walked away by the time the Windows version finally shipped in 1994.

## ■ Windows 95

*Microsoft*

Need we say more?

## List #20 Top Garage Start-ups

Some people store cars in garages, and some also store garden implements and the detritus of the past. Others start multimillion-dollar companies in them. Beats cleaning up oil stains.

### ■ MOM, MAY I BORROW THE VAN?

*Apple Computer*

### ■ PASCAL, CHEAP

*Borland International*

### ■ PHILIPPE HAS A BIG GARAGE

*Starfish Software*

### ■ WIRES AND PLIERS

*Cabletron*

### ■ MOO-VING ON UP

*Gateway 2000*

### ■ NO EGO OR SUPREGO INVOLVED

*id Software*

### ■ GET RICH QUICKEN

*Intuit*

### ■ IS THERE A DOCTOR IN THE HOUSE?

*McAfee*

### ■ WORTH 1000 WORDS

*PictureTel*

### ■ ON A KITCHEN TABLE, ACTUALLY

*Sierra On-Line*

### ■ US, TOO

*BYTE*

### ■ IT'S A LANDMARK

*Hewlett-Packard*



THE HP GARAGE IN PALO ALTO.



We'll give you

# 10 Reasons

to buy a ComByte® Doubleplay™ dual mode drive.

- 1 No configuration headaches** - Unlike stand-alone devices, the dual mode *Doubleplay* tape and floppy is one integrated drive. To the computer it looks and acts just like a floppy drive. No need to set special addresses...just plug and play.
- 2 Installs in half the time** - The *Doubleplay* is both a tape and floppy drive in one dual mode device that will fit in any IBM® or compatible PC. One set of mounting screws, one data cable, one power cable and you're finished... in half the time.
- 3 Easy to use** - No other drive allows you to move files to tape using Windows® File Manager. For users not familiar with tape, there's no need to learn such terms as "backup" and "restore". Drag and drop your files to tape just like it's a floppy.
- 6 Load software twice as fast** - Because the *Doubleplay* floppy section is doublespeed, you can load software applications in half the time.
- 7 Reliability** - With roughly half the parts of comparable individual drives, the *Doubleplay* is much more reliable.
- 8 Use any length tape** - Tape lengths are all over the map. Because we don't believe it's your problem to sort out, we engineered the *Doubleplay* drive to be smart enough to read and write any length QIC 80 tape including the new 1000 foot, 800 Megabyte cartridges by Verbatim® and Gigatek®.

Now  
**800MB**  
With Verbatim or Gigatek  
1000' tape cartridges.



	Tape Drive	Floppy Drive	ComByte Doubleplay
Reads and writes all floppy formats.		✓	✓
Doublespeed floppy.			✓
Copies files from Windows File Manager.		✓	✓
Windows '95 ready - gives user either backup media choice in one device as defined within Windows '95 application.			✓
Reads and writes standard QIC tape formats.	✓		✓

- 5 Industry standard** - Using industry standard formats on both the tape and floppy means that you can exchange data with any 1.44 Mbyte or 720 Kbyte floppy drive and exchange tapes with Colorado®, Conner®, Iomega® or any other QIC80 format tape drive.

- 9 Three year warranty** - We feel so confident about our products that we offer this spectacular warranty.



**Order Now:**



1-800-756-9888

**D&H**

1-800-340-1001

**Liwski**  
INTERNATIONAL, INC.

1-800-454-8754



4424 Innovation Drive, Fort Collins, CO 80525

For product information or your nearest dealer call: 1-800-990-BYTE

Circle 323 on Inquiry Card (RESELLERS: 324).

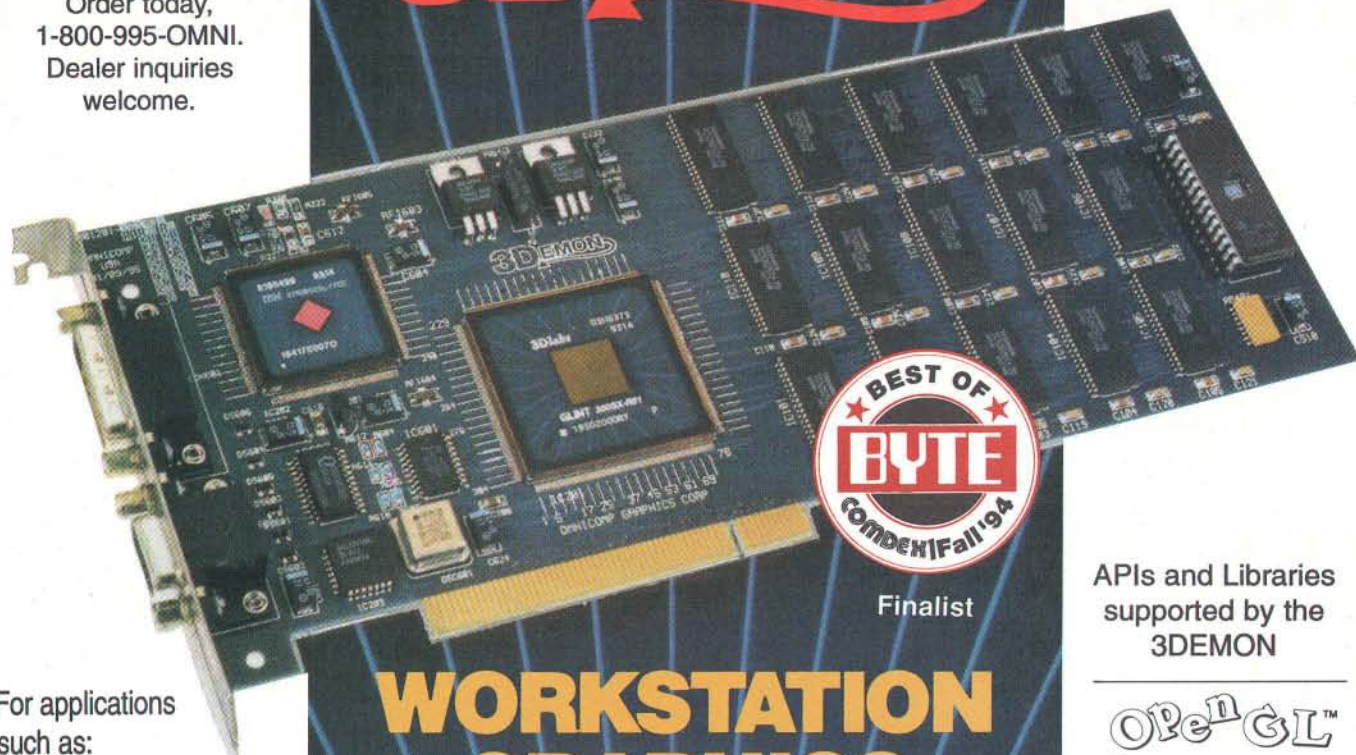


Powered by the  
GLINT™ 300SX

Order today,  
1-800-995-OMNI.  
Dealer inquiries  
welcome.

# 3DEMON

3 year warranty



Finalist

## WORKSTATION GRAPHICS AT PC PRICES

Unleash the power of the 3DEMON™ on your graphics application. Omnicomp now brings you a PCI based graphics accelerator board capable of 3-D workstation class performance at affordable PC prices. The 3DEMON accelerates rendering with 24-bit Z-buffering, anti-aliasing, alpha-blending, texture mapping and fast clear features. For Windows NT™, the 3DEMON provides double buffering and optimizes OpenGL™ applications.

Tomorrow's Vision Today

# Omniscorp

Graphics Corporation

For applications  
such as:

**MicroStation®**  
**OpenInventor®**  
**Pro/ENGINEER®**  
**Pro/JR.™**  
**AutoCAD®**  
**3D Studio®**  
**trueSpace™**  
and others

Call for information on  
our complete line of PC  
and VMEbus graphics  
products.

**OMNISCORP GRAPHICS  
CORPORATION**  
1734 W. SAM HOUSTON  
PKWY. N.  
HOUSTON, TEXAS 77043

PHONE: (713) 464-2990

FAX: (713) 827-7540

email:  
omnicomp@phoenix.phoenix.net

World Wide Web:  
<http://phoenix.phoenix.net:80/omnicomp>

APIs and Libraries  
supported by the  
3DEMON

**OpenGL™**  
• SiliconGraphics, Inc.

**REALITY™  
LAB**  
RENDERMORPHICS

**RenderWare®**  
**criterion  
software**

**BRender™**  
Argonaut

**3DR™**  
Intel®

**X™**  
INSIDE  
INCORPORATED

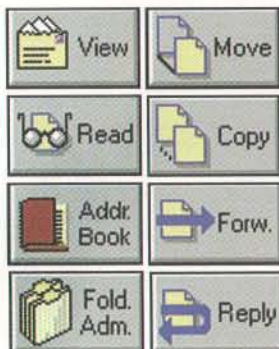
**AUTODESK®**  
REGISTERED • DEVELOPER • SM

Omniscorp and 3DEMON are trademarks of Omnicomp Graphics Corporation. GLINT 300SX is a trademark of 3DLabs Inc., Ltd. Windows NT is a trademark of Microsoft, Inc. OpenGL is a trademark and a copyright, and Open Inventor is a copyright of Silicon Graphics, Inc. RenderMorphics and Reality Lab are trademarks of RenderMorphics, Ltd. BRender and Argonaut are trademarks of Argonaut Software, Ltd. RenderWare and Criterion are trademarks of Criterion Software, Inc. X Inside is a registered trademark of X Inside, Inc. 3DR is a trademark and Intel is a registered trademark of Intel, Inc. MicroStation is a registered trademark of Bentley Systems Inc. Pro/ENGINEER is a registered trademark and Pro/JR. is a trademark of Parametric Technology Corporation. trueSpace is a trademark of Caligari Corporation. 3DEMON is not an Autodesk product. The Autodesk logo is registered in the U.S. Patent and Trademark Office by Autodesk, Inc. All other trademarks or registered trademarks are the property of their respective owners and are hereby acknowledged. The specifications in this document are subject to change without notice.

Circle 297 on Inquiry Card (RESELLERS: 298).



# E-Mail Made E-as-y.



Now PC users on a Unix network can have a Windows-style, Windows-fast & easy interface to Internet and Unix email.

Just use EMBLA and you'll see email couldn't be easier.

- It's Windows "drag & drop" simple

- Remote users — save on your phone bill! You can select and download only the mail you need.
- Supports MIME, IMAP & standard Windows socket API.

EMBLA is available now for just \$99.

Call one of the resellers listed below to order. For more information, contact ICL ProSystems at:  
[marcomms@pro.icl.se](mailto:marcomms@pro.icl.se)  
<http://www.pro.icl.se>



## EMBLA™

**UniDirect**  
800-755-8649  
[sales@unidirect.com](mailto:sales@unidirect.com)

**software.net**  
800-617-SOFT  
<http://www.software.net>

**J.P. Brown** (In Canada)  
416-494-0472  
[davef@jpbrown@uunet.ca](mailto:davef@jpbrown@uunet.ca)

**SOFTWARE PIRATES:**  
(AND YOU KNOW WHO YOU ARE)  
**WE'RE PUBLISHING THIS  
NUMBER SO THAT YOU  
WILL BE TURNED IN.**

**DON'T  
COPY  
THAT  
FLOPPY.™**

**1-800-388-7478**

**SOFTWARE  
PUBLISHERS  
ASSOCIATION**

©1994 Software Publishers Association



*You'll find it in the heartland of America.*

*...in the hot and dusty cab of a giant combine,  
using a GPS and recording crop yields*

*You'll find it in demanding environments*

*...such as hospitals supplying critical Point-Of-Care  
information at the touch of a finger*



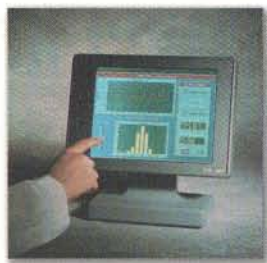
When faced with selecting  
PC for control or data  
processing systems,  
designers usually must  
choose between a desktop  
system, notebook or an  
expensive single board  
industrial computer.



DATALUX now offers an  
alternative with the  
essential PC system  
components in a series  
of unique packages that  
both save space and are  
easy to integrate.

## THE DATABRICK from DATALUX

A **tough, compact PC** solution that offers the modularity of a desktop  
system and the **small size** of a notebook.



### Stand-Alone LCD Monitors

DATALUX is in its 4th year of LCD monitor  
manufacture and is an industry leader. Its  
new LCD Monitors use brighter 10.4"  
diagonal Dual-Scan or TFT Color panel in a  
rugged, sealed, yet attractive housing with a  
selection of 8 wall or base mounting options.  
Resolution is 640 x 480. The monitors can  
be driven directly from a Databrick or  
through an ISA bus controller. No external  
power is required. An integrated resistive  
**Touch Screen** is optional with input  
through one of the Com Ports. Monitors may  
be extended to 50' from the CPU.



### Keyboards

The Space-Saver keyboard is the smallest full  
function 100 key keyboard available. With  
standard left right spacing touch typing is easy  
yet the overall size is only 6" x 10.75".  
It is available in a flat, panel mount or desktop  
model. The Glidepoint® pointing device is avail-  
able as an option.



### Databrick Vertical Systems

The new DATALUX Databrick  
Vertical System (DVS) combines  
the Databrick, LCD Monitor and the  
Space-Saver Keyboard in a unique  
enclosure for Wall, Swing Arm, or  
Pedestal Mounting. The all alu-  
minum housing provides compact-  
ness and security. The monitor  
screen tilts to accommodate the  
height of the user. A variety of  
options include bar code and mag  
stripe readers, speakers, or a small  
printer. The DVS measures 13.5" x  
19.6" x 3.2".

### Databrick

The Databrick is the heart of the DATALUX system. In performance and fea-  
tures it is more like a desktop unit, in size comparable a notebook  
(10.25" x 4.8" x 2"), yet more rugged and more  
easily mounted than either.

### Specifications:

486DX2/66 or DX4/100 CPU  
2-64 Meg Standard SIMM DRAM  
Internal or External FDD  
Internal HDD to 540 Meg  
SVGA CRT and LCD Video Ports w/1Meg  
2 Serial, 1 Extended Parallel Port

### Options:

2 slot PCMCIA  
10Bt Ethernet LAN  
Com Ports 3 & 4  
DC-DC Power converter



DVS shown here  
on Rolling Stand

**FAX BACK  
DATA SHEETS  
(540) 662-1675**

Circle 291 on Inquiry Card.

# DATALUX

**Datalux Corporation**  
155 Aviation Drive  
Winchester, Virginia 22602  
Phone: (540) 662-1500  
Fax: (540) 662-1682  
Toll Free: 1-800-328-2589  
(1-800-DATALUX)

**Datalux International, LTD**  
Euro House Curtis Road,  
11 Old Water Yard  
Dorking, Surrey  
UNITED KINGDOM RH41EJ  
Phone: 44+(1)306-876718  
Fax: 44+(1)306-876742



WE WILL TRY TO MATCH OR BEAT ANY ADVERTISED PRICE. CALL FOR LATEST PRICING!!

WE ACCEPT PO'S  
FROM QUALIFIED FIRMS

MEMORABLE

SECURITY WILL CALL WINDOW NOW OPEN!  
NO SURCHARGE FOR MC, VISA AE & DISCOVER

## CACHE MEMORY

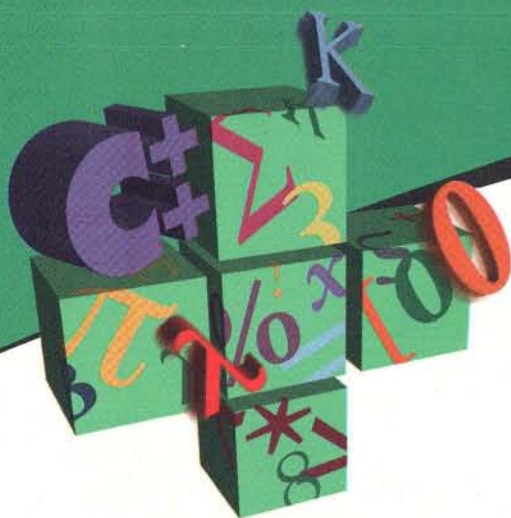
	12WS	15MS	20WS	25WS
8Kx8	5.50	6.50	8.00	9.50
16Kx8	10.00	11.00	13.00	15.00
32Kx8 (2x)	14.00	15.00	17.00	19.00
64Kx8	18.00	19.00	21.00	23.00
128Kx8	22.00	23.00	25.00	27.00
256Kx8	26.00	27.00	29.00	31.00

## Individual D-RAM Chips

	50NS	60NS	70NS	80NS	100NS
1Mx91	-	8.85	6.45	5.95	4.95
1Mx91	-	49.00	39.00	38.00	-
1Mx91 (Zip Pk)	-	24.00	22.00	21.00	-
256k4 (Page Dip)	-	7.25	6.75	6.50	5.95
256 k4 (Static Dip)	-	-	9.95	-	-
256k4 (Page Zip)	-	9.25	9.00	8.95	-
256k4 (Video Zip)	-	-	12.95	11.95	9.95
256k4 (SCU)	-	29.00	24.00	-	-
256 k4	-	9.25	2.66	2.78	2.25
64k4	-	-	-	3.75	-
64k4	-	-	-	-	3.00
256k16 SCU	-	-	29.00	-	-
256k16 Video Zip	-	49.00	39.00	-	-



# Move to the Plus Side of Math –



Just  
Released!

## IMSL® Math Module for C++ . . .

*positively the easiest way  
to develop technical applications!*

### Get your math from the math experts.

Now the object-oriented development tools you need are available from the name you have relied on for nearly 25 years for numerical analysis and technical application development. The IMSL Math Module for C++ is the first release from Visual Numerics' new family of object-oriented development tools, Visual Numerics ObjectSuite™.

The **IMSL Math Module for C++** uses the power and flexibility inherent in the C++ language to greatly reduce coding requirements. The combination of powerful algorithms and ease-of-use makes the **IMSL Math Module for C++** ideally suited for object-oriented programmers building business, scientific, and research applications. The Module's object-oriented interface provides a natural algebraic approach to mathematical programming.

- Includes classes in a variety of precisions for
  - complex arithmetic
  - vectors
  - matrices (symmetric, positive definite, general)
  - matrix decomposition (QR, LU, Cholesky, SVD, Diagonal Pivoting)
  - interpolation and approximation
  - pseudorandom number generation (uniform, normal, Poisson, gamma, beta, exponential)
- Conforms to established conventions of C++ programming.
- Built upon efficient algorithms.
- Includes comprehensive online documentation.

#### Here's why you should build your applications with the IMSL Math Module for C++:

- Speed your application development.
- Reuse our code and expertise.
- Reduce complexity and simplify maintenance.
- Develop object-oriented cross-platform solutions.
- No run-time fees.

#### Supported systems:

- Intel-based PCs running Windows with Win32s or Windows NT
- Sun Microsystems and Hewlett-Packard workstations
- Coming soon for Windows 95 and IBM RS/6000

Circle 333 on Inquiry Card (RESELLERS: 334).

**IMSL** Fortran and C/C++  
application development tools

Visual Numerics and IMSL are registered trademarks and ObjectSuite is a trademark of Visual Numerics, Inc. Windows, Windows NT and Windows 95 are trademarks of Microsoft Corp. All other product names are trademarks of their respective owners.

*See why over 250,000 developers worldwide use IMSL  
for mission-critical applications.*

Get your math from the math experts. Call today!

## 1-800-364-8880

Visual Numerics®

phone (713) 954-6785 fax (713) 781-9260

e-mail: [marketing@houston.vni.com](mailto:marketing@houston.vni.com)

<http://www.vni.com>

London +44 (0) 1753-790600 • Paris +33-1-46-93-94-20  
Stuttgart +49-711-13287-0 • Tokyo +81-3-5689-7550



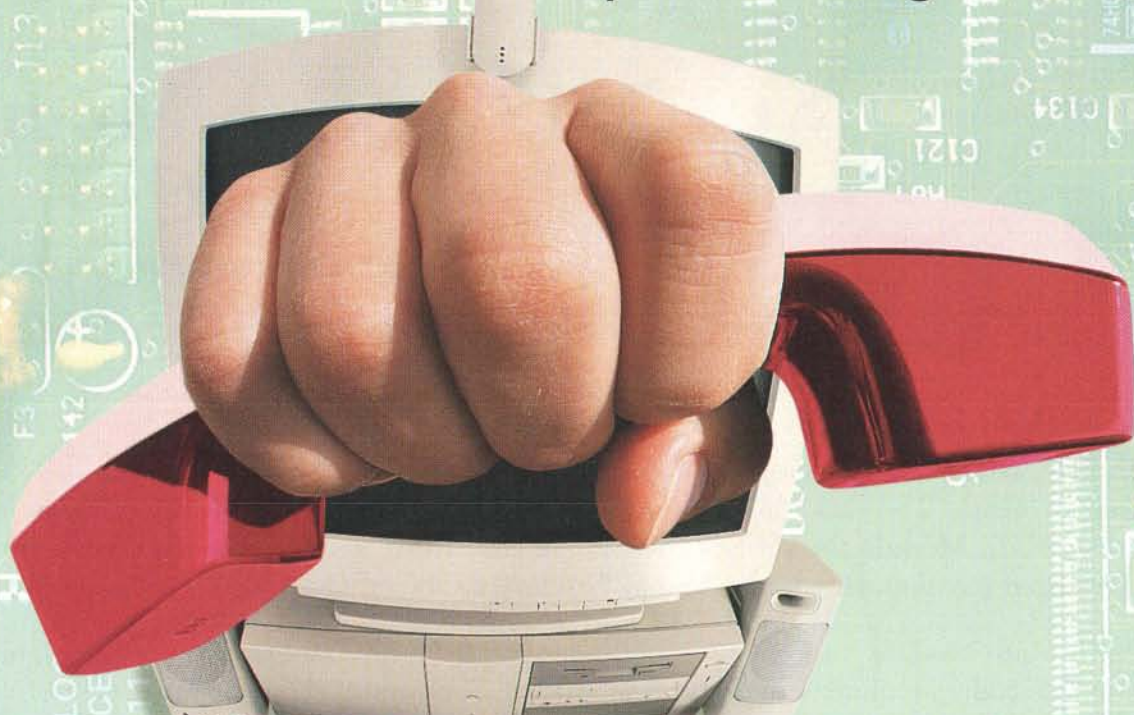
AD95116



# EASYCOM GALILEO

## Just Plug & Phone!

The true PC and telephone integration.



Record instantly your telephone conversation while speaking and replay it a moment later to the person you are speaking to ... or paste it into any of your documents or presentations! Play your new CD on the telephone to your remote interlocutor while speaking! Talk on the phone while playing the most sophisticated games! Scan documents with your local fax machine while phoning or receiving an external fax! Drive EasyCom Galileo phone functions through DTMF keys! ... and much more!

## All communication features integrated: Telephony + Sound / Voice / Modem / Fax

### General specifications:

ISA 16 bits Plug & Play, powerful proprietary interface (COM port independent), totally evolutive (DSP based), auxiliary COM port emulation for full compatibility with any communication software. Windows 3.1, 3.11 and DOS drivers.

### External I/O connections:

Microphone input, line-in, CD-in, line-out, motherboard speaker in, speakers out, phone line, handset line.

### Integrated Telephony:

Twin independent lines (handset/local fax and external phone line), powerful handset management, full duplex handset and/or speakerphone, spy mode, recording and replay phone conversation, PBX management directly from the PC (calls transfer and routing), access to telephone directories in any database.

### Audio & Sounds:

16 bits Stereo / 48 Khz sound and OPL3 synthesis, MPC II & Microsoft Sound System compatible, Sound Blaster and Ad Lib games compatibility, MPU 401 MIDI Interface (uart), IDE CD-ROM interface.

### Voice Mail System:

Countless Voice servers and Answering machines, Fax on demand and remote querying / DTMF keys.

### Fax / Modem 14400:

V32bis, V32, V22bis, V22, V42, V42bis.

Terminal emulation and transfer.

V17, V29, V27ter, V21, V23.

Std. COM port, Class 1 & 2 protocols.

### Software:

All functions are fully integrated and managed by the powerful native EasyCom software under Windows 3.1, 3.11 and Windows 95.

### By BuroBotics

Rte Suisse 9, 1295 Mies, SWITZERLAND

+41 22 7792255 tel. or 22 7791504 fax

CompuServe : 100063,2624



Visit us at COMDEX 95

Windows standards compatibility, all Windows compatible networks supported.

PTT approval in more than 15 worldwide countries in process. Competitive price policy.

Distributors and OEM integrators welcomed.

Circle 331 on Inquiry Card (RESELLERS: 332).



# Dis(K)organized?



**DiskEasy**<sup>™</sup> is the easy-to-use Diskette Management, Inventory and Labeling program designed for everyday computer use. DiskEasy is the only tool you need to

organize, manage, label and catalog your diskettes – and the information they contain.

Now compatible with **Microsoft Windows 95**

■ **Automatic Diskette Inventory**

Simply insert the disk and click on the Read & Store button to automatically add it to your inventory.

■ **Full Search/Find Features**

Locate files and documents contained on a specific diskette in just seconds. No more searching through stacks of diskettes.

■ **Re-usable Label Sheets**

Choose which labels on a sheet to print, and run sheet through the printer multiple times.

■ **New On-Screen Graphic Format**

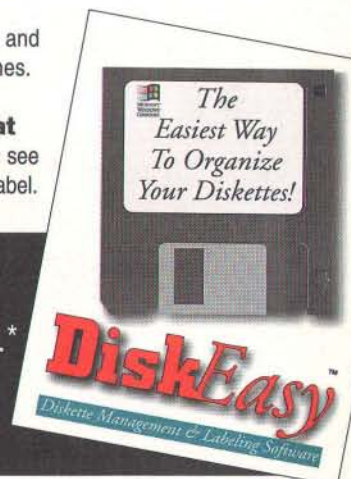
Easy graphic format for data entry lets you see your information as it will appear on your label.

## Order DiskEasy today!

Receive DiskEasy plus **FREE** 180 laser diskette labels for only \$34.95.\*

**Call 800-771-EASY** or outside the US call 214 526 2446 or fax 214 526 6436

\*Includes Shipping and Handling. Texas customers add 8.25% sales tax. We accept Phone Check, Mastercard and Visa



30-day money-back guarantee (less \$6.95 shipping/handling charges). Prices are for US only. Canadian residents add \$3.00, other countries add \$20.00. Prices subject to change without notice. IBM PC or compatible running Windows 3.1, VGA or better. Mouse compatible device, and minimum 4MB RAM required. ©1995, Verot Publishing Group, Incorporated. DiskEasy is a product of the Verot Publishing Group, Incorporated. All other products, names or logos are copyrights of their respective owners. Verot Publishing Group, Incorporated. 4514 Cole Avenue, Suite 600, Dallas, TX 75205 800-771-EASY

Circle 337 on Inquiry Card (RESELLERS: 338).





Yes ma'am,  
you can drive those  
**UNIX** apps from  
your PC now.

## XoftWare® PC X servers. The full-service solution.

**W**here can you find a one-stop solution for desktop-to-UNIX connectivity? With XoftWare, it's all in one place. In fact, it's the only X server that connects all your Windows, Windows NT, DOS, OS/2, Macintosh and PowerPC systems to your UNIX destinations. What's more, it's built for speed (fasten your seatbelt!) and fully loaded with administrative tools. The result? An easy maintenance, IS-friendly X server with high-performance UNIX access from all your desktop systems. So why not take it for a test drive? Call us at **1-800-PICK-AGE** (1-800-742-5243) or e-mail us at [sales@age.com](mailto:sales@age.com) for your introductory copy.

**\$99**

1ST-TIME OFFER

Circle 303 on Inquiry Card (RESELLERS: 304).



**AGE Logic, Inc.** 12651 High Bluff Drive, San Diego, CA 92130  
Tel: 619.755.1000 Toll Free: 1.800.742.5243 East Coast: 1.800.722.3702  
Fax: 619.755.3998 e-mail: [sales@age.com](mailto:sales@age.com) Internet: <http://www.age.com>

XoftWare is a registered trademark of AGE Logic, Inc. All other trademarks are the property of their respective owners.



# The Micro International 7600 Notebook.

## THE BEST NOTEBOOK VALUE COMES FROM HOUSTON!

Raw power is just the  
beginning of what  
you get for only

**\$2660.**

Built-in multimedia speakers  
for the built-in soundblaster  
compatible 16-bit soundcard!

Two type II PCMCIA card  
slots (equal to 1 type 3)

340mb removable local bus  
HD (up to 810mb available)

8mb RAM (up to 40mb using  
user-upgradeable modules)  
and 256K L2 cache!



Brilliant 10.3" Dual-scan  
Passive Matrix Color  
screen (Active Matrix  
also available).



Mic in / Speaker /  
Headphone out jacks

3.5" floppy drive

19mm trackball in  
just the right spot

Dependable  
NiMH Battery

## *A focus on service and support since 1984!*

We give you *free* lifetime *toll-free* tech support. We *preload* the latest versions of DOS and Windows for Workgroups, including all video, sound, and PCMCIA card utilities. Our 1 Year Parts and Labor Warranty includes our outstanding 48 hour warranty service turnaround time, *proving* that we understand how you depend on our products. Our 30-day money back guarantee is *pretty simple*: you get a refund\* if you're not satisfied for *any reason*. Our RealHelp disk included with every notebook allows us to service your technical configuration files *by remote access*. Our 48-hour+ extensive burn-in and testing period on every single notebook, *before* it leaves our facility, ensures an absolute minimum of failures in *your notebook*. Anything less is just not mint!

\* Shipping charges will be withheld from the refund.

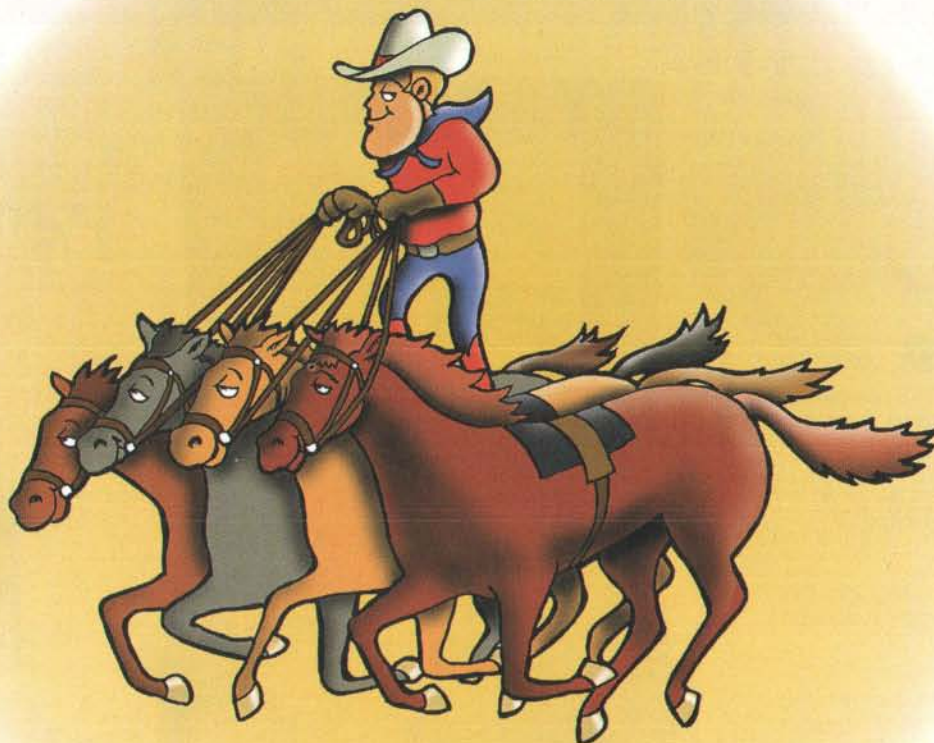
Micro International, 10850 Seaboard Loop, Houston, Texas 77099. Top quality service and support **since 1984!**  
Full information (including specifications, all options & prices) available by fax or mail on request.  
Fax (713) 495-7791 Hours: 8-6 Monday-Friday. Call today toll free:

\*Pentium is a registered trademark of Intel Corporation.

# 1-800-967-5667



# Take the Reins of Consolidated Control!



## **AutoBoot Commander Personal Commander**

The industry standard AutoBoot Commander allows you to monitor and control up to 96 PCs or file servers with just one keyboard, monitor and mouse. For desktop control of smaller installations, give our Personal Commander a try!



## **Slimline Commander Magnum Commander**

The most streamlined members of the AutoBoot family, these Commanders are designed specifically for all your rack mount applications. Choose the 1.75" (1U) Slimline for 19" racks, or the 3.5" (2U) Magnum for 19, 23, or 24" racks.



## **AutoBoot Commander 4xP/1xP**

The most advanced AutoBoot products yet, the 4xP and 1xP add multiuser, multiplatform and multimedia capabilities to the Commander world. Control PC, Mac and Sun computers from one location! Use the 4xP for larger installations; try the 1xP for desktop control of smaller configurations.

**Cybox Corporation**  
4912 Research Drive Huntsville, AL 35805 USA  
(205) 430-4000 (205) 430-4030 fax  
<http://www.cybox.com/>



COME SEE US AT  
Networks Expo, Dallas, TX; Sept. 12-14 1995 Booth #1696 &  
Network + Interop, Atlanta, GA; Sept. 27-29 1995 Booth #5166

PC is a registered trademark of International Business Machines Corporation. Mac is a registered trademark of Apple Computer, Inc. Sun is a registered trademark of Sun Microsystems. Cybox, AutoBoot, Commander, Slimline, 4xP and 1xP are trademarks of Cybox Corporation.





# Web Site, Internet Gateway, and Workgroup Suite — All In One.



## Introducing Worldgroup Internet Server

### Workgroup Stuff

- Free Windows Client
- Teleconferencing/Chat
- Electronic Mail
- Group Message Forums
- File Libraries
- Polls & Questionnaires
- Multimedia File Launch
- Modem Access
- LAN Access
- Internet (TCP/IP) Access
- ISDN Access
- X.25 Access
- Offline Client Use
- Transparent Updates

### Internet Stuff

- SLIP/CSLIP/PPP Access
- Pass-Thru Web Browsing
- Web Server
- Web Forms Support
- VRML & Java Support
- CGI Web Server API
- Web Usage Reporting
- SMTP Send & Receive
- NNTP Send & Receive
- IRC Client
- Telnet Client & Server
- Rlogin Client & Server
- FTP Client & Server
- Finger Client & Server

### And More Stuff

- Up to 256 Connections
- Interactive Sessions
- Multithreaded Engine
- ASCII/ANSI Access
- Administrative Reports
- Locks & Keys Security
- Unlimited User Classes
- Remote Management
- Visual Basic API
- ISV Credit Card Verifier
- ISV Photograph Database
- ISV Group Calendar
- ISV Document Retrieval
- ISV Shopping Mall

On one PC, you can easily provide full access to and from the Internet. You can have a stunning Web site that engages a client/server workgroup environment. And you can provide a gateway to the Web for your modem and LAN users.

You can do all of this and more with the Worldgroup Internet Server — on a

single 486 or Pentium DOS machine. Minimal maintenance. Maximum impact. With airtight security and easy administration. Starting at \$1,495.

You can add client/server databases, order entry, voice/image conferencing, and more with a quick "A:INSTALL" — no laborious HTML work.

To use the Internet for real business, give us a call at 1-800-328-1128 (outside U.S. and Canada call 305-583-5990). Or browse us at <http://www.gcomm.com>.



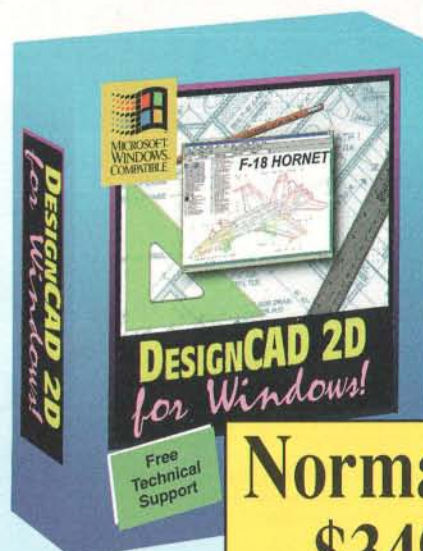
**GALACTICOMM**  
Bringing your vision online



# Step up to the best. DesignCAD. Only \$99. (competitive upgrade)

Now, for the first time in our ten year history of CAD software, we are offering a \$99 competitive upgrade to DesignCAD. What does this mean? If you own any other CAD, Drawing, or Design software, you can step up to the best - DesignCAD. This is the complete, up-to-date package - not an older or limited version. For \$99 you get your choice of the DesignCAD 2D for Windows (version 7.0) or the new Windows 95 version.

Why are we doing this? Why are we offering \$349 CAD software for \$99? Because we believe it's the best, and we're sure you'll find it a significant improvement. **In fact, we're so sure you'll like it we're offering a 30-day money back guarantee.** Get the DesignCAD Competitive Upgrade for only \$99, try it out, and if you're not satisfied for any reason send it back for a full refund, no questions asked.



**Normally  
\$349**

**30 Day Money  
Back Guarantee**

**Free Technical  
Support**



**YES! Send me the DesignCAD Competitive Upgrade for only \$99. I am the owner of the following CAD, Drawing, or Design software:**

I would like DesignCAD for: ☐ Windows 3.1 ☐ Windows 95

Payment Method:

☐ Visa ☐ MC ☐ Amex ☐ Discover ☐ COD ☐ Check/Money Order

Card Number: \_\_\_\_\_ Exp: \_\_\_\_\_

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Address: \_\_\_\_\_

City, State, Zip : \_\_\_\_\_

Phone: \_\_\_\_\_

Call, Mail, or Fax your order:

American Small Business Computers, One American Way, Pryor, OK 74361

A120 (800) 233-3223 (918) 825-7555 fax (918) 825-6359

**To get yours, call (800) 233-3223**



**PLUG**



**One Portable CD-ROM Drive — Two Simple Steps**



**PLAY**

With the backpack quad-speed CD-ROM drive, you're one cable connection away from a world of multimedia business advantages: Plug it into your PC parallel port to access a universe of CD-ROM titles. Take it with you for portable data retrieval. Or share it with other PCs.



**backpack**

**MicroSolutions**

Call Toll Free - 800.295.1214

No compatibility problems with virtually any IBM-compatible PC—Windows, DOS or OS/2. No taking your PC apart to install this quad-speed drive. Just plug it into your PC printer port—plug your printer into the backpack. A simple solution from the backpack family of tape, diskette and hard drives.

**NOW AVAILABLE WITH 16-BIT BUILT-IN SOUND OPTION!**

132 W. Lincoln Hwy. DeKalb, Illinois 60115 • Telephone 815.756.3411 • FAX 815.756.2928

Circle 294 on Inquiry Card (RESELLERS: 295).



# 17" MONITOR FOR - \$469

PC MALL  
(800) 555-6255  
Tiger Direct (FL)  
(800) 888-4437  
USA Flex (IL)  
(800) 477-8323



**Free Software!**  
For a limited time, buy a Tympani & receive presentation software, (\$99 Value) FREE!

## The Tympani - More Bang For Your Monitor Buck!



The Orchestra Diva is singing again. This time, it's about our new 17" Tympani monitor. Now, for \$469, you can have a 17" screen, with two-thirds more Windows screen area than a 15" screen. Get a bigger, better and brighter image for larger text and more vivid multi-media impact.

All that extra screen area, with a maximum non-interlaced resolution of 1024x768, for an estimated street price of only \$469!

### More Screen For Your Buck

Even with a \$469 price tag, the Tympani offers pincushioning control and Energy Star compliance, with DPMS power management.

For more features and performance, look to Orchestra's newest 15" and 17" displays, the French Horn II and the Tuba II.

### You're In Control With Advanced On-Screen Display

The French Horn II and Tuba II support high refresh rates and have advanced On-Screen Display controls for adjust-

ing image geometry and color. Adjust the tilt/rotation, pincushion/barreling and trapezoid aspects, so your image is sharp, square and stable, just the way you like it.

Moreover, color balancing allows adjustment of Red, Green and Blue, so you can match your screen color to your printer output, or maybe just your mood.

Call us at (800) 237-9988 from 8:30am to 5:30pm, PST

and ask a product specialist about the full line of Orchestra 14", 15" and 17" displays as well as the Tempo Series of PCI and Vesa Local Bus video adaptors.

For all your monitor needs, Orchestra has a model to fit your computing style.

For more information, or to find a dealer nearest you, call today. The Diva is singing for Orchestra; let Orchestra perform for you.

	Tympani	Tuba II	French Horn II
Dot Pitch (mm)	0.42	0.28	0.28
Maximum Resolution (Non-interlaced)	1024x768	1600x1280	1280x1024
Trapezoidal Control	NO	YES	YES
Tilt/Rotation Control	NO	YES	YES
Pincushion Control	YES	YES	YES
Color Balance Control	NO	YES	YES
Color Temp. Control	NO	YES	YES
Microprocessor Controls	NO	YES	YES
On-screen Controls	NO	YES	YES
Estimated Street Price	\$469	\$699	\$499



ISO 9001

(800) 237-9988

© 1995 Orchestra MultiSystems, Inc. All trade names are trademarks of their respective companies.

**Orchestra**  
MultiSystems, Inc.  
Technology in Concert





E-mail messages are like fish: You don't want to let the big ones get away, but you need to screen out the little stinky ones. Eudora Pro has message filters that you can pre-set to separate the Big Mouths from the Barracudas.

Eudora Pro™ is like an Ultimate Cruising Machine. Since it uses TCP/IP, your messages glide effortlessly across WANs and through LANs, without having to pass through cumbersome gateways. That's why it's the e-mail of choice for the Internet.



# When buying proprietary e-mail, you may just get more than you bargained for.

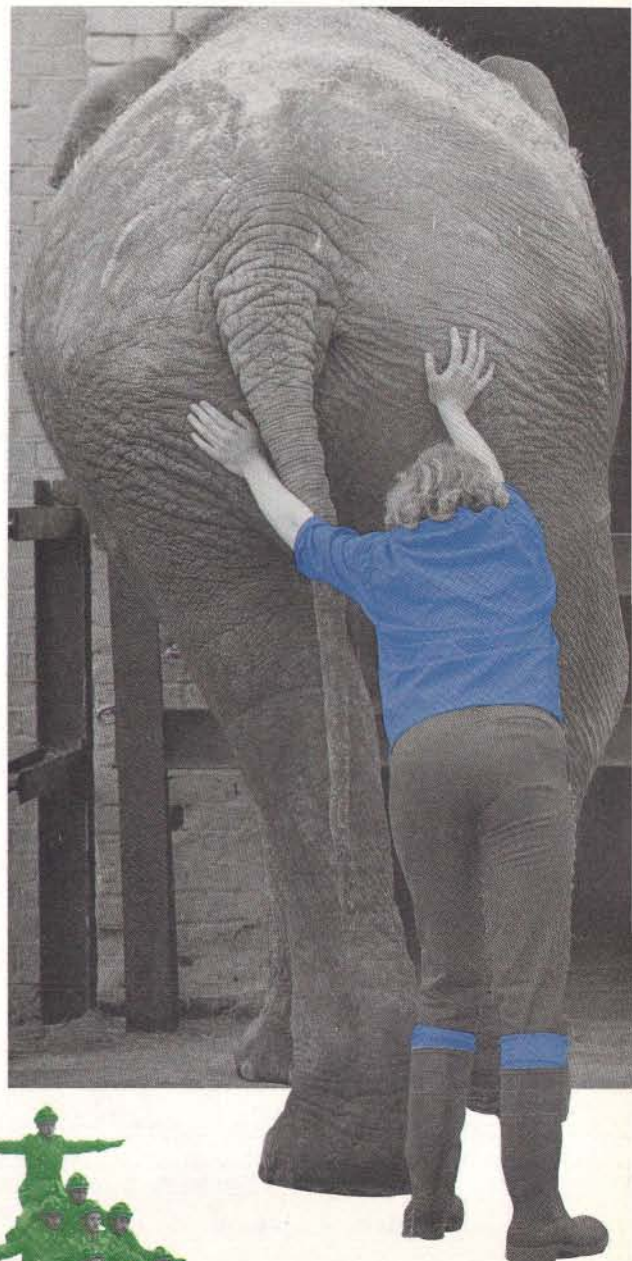
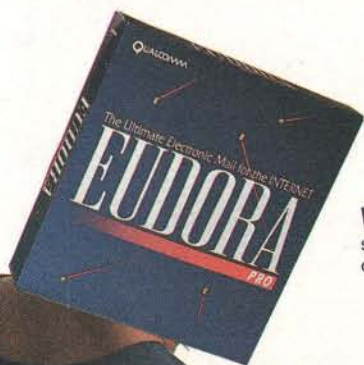


Over two million Mac and PC users aren't the only ones applauding Eudora. MacUser selected Eudora Pro as the best communications software of 1994.



Most proprietary e-mail applications have really great front ends (GUIs) and tons of features. But try pushing one through a gateway without getting something trampled on... like your message. Not a pretty sight!

Want security? Eudora Pro uses a sophisticated authentication system called Kerberos to guard your mailbox.



Is your system administration group balancing proprietary e-mail systems against low maintenance, interoperability and ease of use? Can't be done! Try an open system. Try Eudora Pro!

For more information, contact your local dealer. For a listing of authorized Eudora resellers and distributors, call: 1-800-2-EUDORA ext. 6083; e-mail: [eudora-sales12@qualcomm.com](mailto:eudora-sales12@qualcomm.com); fax: 619-658-1500; worldwide web address: <http://www.qualcomm.com/QualHome.html>.

**QUALCOMM**

Circle 307 on Inquiry Card (RESELLERS: 308).

The Apple logo is a trademark of Apple Computer Inc.

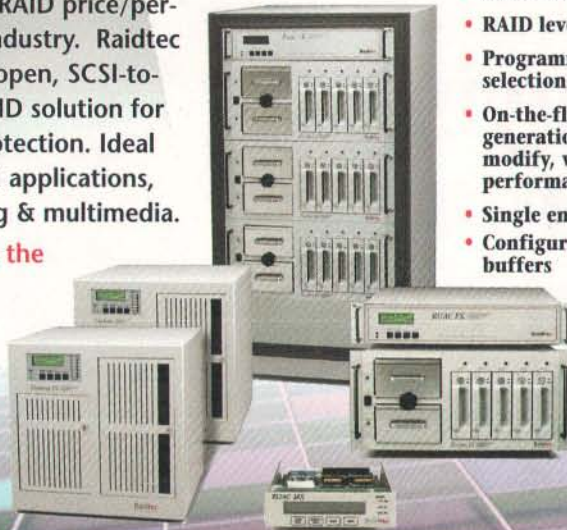


# Defacto RAID

## High-Performance SCSI RAID Systems

Discover the best RAID price/performance in the industry. Raidtec is the affordable, open, SCSI-to-SCSI hardware RAID solution for complete data protection. Ideal for mission critical applications, document imaging & multimedia.

It's time to re-visit the ultimate in high-availability storage. Contact Raidtec today at (404) 664-6066.



- Fast & Wide SCSI II
- RAID levels 0, 1, 10, 3/5
- Programmable RAID Level selection
- On-the-fly hardware parity generation eliminates read, modify, write-back performance overhead
- Single ended or differential
- Configurable read & write buffers
- Rackable, stackable
- Downloadable flash firmware
- Remote alarms, configuration & monitoring
- Environmental sensor ports
- "Hot Replaceable" disk drive bays & power supplies
- Single SCSI ID
- Solid state load sharing power subsystem
- LCD control panel status display

### THE STANDARD IN ADVANCED MASS STORAGE SYSTEMS

Raidtec USA  
105 Hembree Park Dr. • Suite C  
Roswell, GA 30076  
Tel.: (404) 664-6066  
FAX: (404) 664-6166

Raidtec EUROPE  
Glen Mervyn House • Glanmire  
Cork, Ireland  
Tel.: (353) 21-821454  
FAX: (353) 21-821654

# Raidtec

CORPORATION

# You Can Save Hundreds of Dollars With Only A \$5 Investment

**GUARANTEED!**

***If you are looking to purchase a computer or computer-related product,  
WE CAN TELL YOU WHO HAS THE LOWEST PRICE!***

Computer Purchaser's Help Line is a research company that has been sourcing vendors for large corporate and government contractors for years. Now we are offering the same service to the public. We can give you access to vendors who normally do not sell to the public. If you have decided what product to buy, we can tell you who has the lowest price.

***OUR GUARANTEE: If you find a vendor who will sell you the same product for a lower price than the source we gave you, we will pay you \$10!\* You have nothing to lose! You just save \$\$\$ on your purchases!***

Just imagine how much you can save on your next Computers, Printers, Memory, Fax/Modems, Hard Disk Drives, CD-ROM Drives, Multimedia Upgrades, Plotters, Digitizers, Software, Networking Products...

***To Save on Your Next  
Purchase, Call:***

**(900) 9-SOURCE**

**Mon-Fri 9-5 PST  
(900) 976-8723**

**LIVE  
OPERATOR!**

Our charges are only \$4.99 for the first minute plus \$1.99 for each additional minute. You can check on as many prices as you want with only one call.

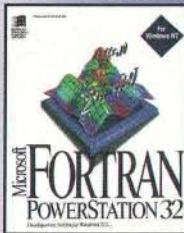
**Computer Purchaser's Help Line**

All price guarantees are for 24 hours. The vendor who is offering you the lower price must sell nationwide and must offer the same price to everyone and have stock. You need to call us at (714) 852-8249 and give us the name of the vendor, phone number and your referral number. We will give you an approval number and mail you a check for \$10.



# SciTECH *Best Sellers* at great prices SOFTWARE FOR SCIENCE

SCIENTIFIC,  
ENGINEERING  
& TECHNICAL  
SOFTWARE  
IS OUR  
SPECIALTY.

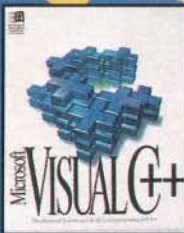


## MICROSOFT® FORTRAN POWERSTATION

Develop & run Fortran programs of virtually any size & complexity with Microsoft FORTRAN PowerStation family of 32-bit development systems! Migrate Fortran code from other platforms with little or no modification! Get unparalleled price/performance!

Save time in code development and maintenance using the Windows integrated development environment. Call NOW to order or request a FREE Test Drive Kit!

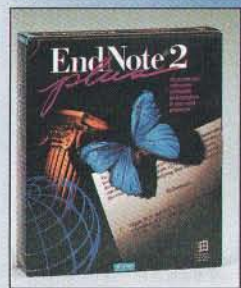
DOS & Windows price .....\$349  
Windows NT price .....\$519



## MICROSOFT® VISUAL C++

If you program in C or C++ and use MS DOS®, Windows® or Windows NT™, Microsoft Visual C++™ (version 2.0) is THE product to use. Visual C++ features an optimizing compiler and a state-of-the-art Integrated Development Environment that includes a project manager, incremental linking; just in time debugging; books online and a whole lot more! Get outstanding value by enrolling in the subscription program.

Single product price .....\$399  
Subscription price .....\$499

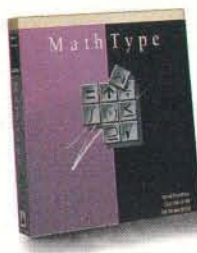


## EndNote Plus

Bibliography maker that creates bibliographies in your word processor. Comes with a collection of bibliographic styles for more than 240 leading academic journals. Choose from these or create your own. Flexible searching and sorting functions help you to organize your references. EndLink, sold separately, imports references downloaded from online or CD-ROM

directly into your EndNote database. *New Windows Version!*

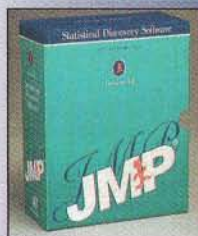
Windows, Mac price .....\$199



## MathType

Upgrade your Equation Editor to MathType. Get the full-featured version of the Equation Editor that comes with Microsoft Word and many other Windows and Macintosh applications. MathType is as easy to use as Equation Editor and you get a lot more features to help you work faster and produce better looking documents.

Windows, Mac price .....\$129  
Upgrade from Equation Editor .....\$89

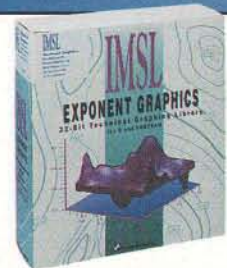


## JMP®3.1

*Statistical Discovery Software*  
from SAS Institute, Inc.

Statistics is not just data reduction and analysis, it's data discovery. JMP's unique graphical approach to statistics allows you to see your data from many different perspectives quickly, easily. JMP's ever-growing list of statistical features includes: extensive linear and nonlinear model fitting, including regression, ANOVA, MANOVA, and random effects models. Statistical quality control analysis, extensive survival analysis, and exclusive integrated design of experiments.

Mac, Windows price .....\$599



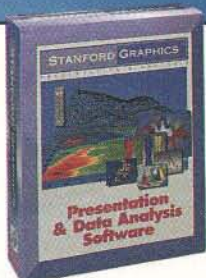
## IMSL EXPONENT GRAPHICS

2D and 3D graphics library for technical applications that includes a Fortran and C application programming interface, built-in GUI for Graph customization and hundreds of code samples. Works with Microsoft's PowerStation 32 and Visual C++ compilers.

NT price .....\$895  
Academic price .....\$715

## STANFORD GRAPHICS

With Stanford Graphics' Graph Gallery of 171 graph types, you'll always find the right graph for your technical data. Error bar charts, X-Y plots, bubble plots, histograms, 3D surfaces and contours, and curve fitting are just a few of the graph types available. Link your Excel, Lotus 1-2-3 or ASCII files directly into a powerful 4-dimensional spreadsheet.



Windows price .....\$99  
Windows NT price .....\$229

To order or for more information call  
**1.800.622.3345**  
ask for our free 116-page catalog with  
more than 2,000 products!

(M-F, 7:30am - 6pm CST)

(Fax 312.486.9234, 24 hours)

See us on the Internet! Our URL is <http://www.scitechint.com/scitech/>

**SciTech**

SciTech International, Inc. 2525 N. Elston Avenue, Chicago, IL 60647-2003 Tel 312.486.9191  
Resellers call 1.800.622.3320 for a Confidential Reseller Price List

Circle 309 on Inquiry Card.

GET EXPERT  
TECHNICAL  
SUPPORT  
BEFORE YOU  
BUY.

CALL FOR  
MORE INFOR-  
MATION &  
FREE DEMO  
DISKS.

30-DAY  
MONEY BACK  
GUARANTEE

GET  
PERSONAL  
ATTENTION  
EACH TIME  
YOU CALL.



# Growing Your Software Business Can Be Puzzling...

Piracy Protection



Pre-Sales Evaluations



Software Rental



Version Updates



Complex Licensing Schemes

## Watch The Pieces Come Together.



### Introducing The ON Button™ For Your Software

Now you can protect your software by *controlling the right to use.*

Buttons are microchips packaged in coin-shaped, stainless steel cans that contain critical information to make your software run.

Ask about dongle trade-in program.

All Buttons contain a unique 64-bit serial number:



**DS1420 ID Button™:**  
Basic security.



**DS1425 Multi Button™:**  
2K bits of RAM can protect multiple applications.



**DS1422 UniqueWare Button™:**  
1K bit of memory separated into 4, one-time-write pages.



**DS1427 Time Button™:**  
4K bits of RAM, along with a tamper-proof real time clock.

Buttons tie together the pieces of your business puzzle.

**DALLAS SEMICONDUCTOR**

4401 South Beltwood Parkway ♦ Dallas, Texas 75244-3292 ♦ Tel: 800-258-5061 ♦ Fax: 214-450-3869

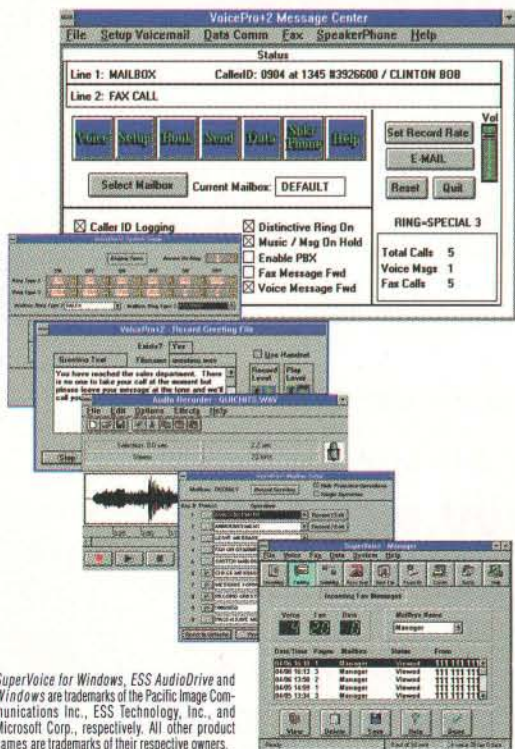
Circle 306 on Inquiry Card.

## Special Introductory Price \$299.00

THE 2-LINE VOICE/DATA/FAX AND AUDIO SOLUTION YOU'VE BEEN WAITING FOR...

## VoicePro+2™

The 1st Affordable 2-line VoiceMail/Fax/Data & Sound System



SuperVoice for Windows, ESS AudioDrive and Windows are trademarks of the Pacific Image Communications Inc., ESS Technology, Inc., and Microsoft Corp., respectively. All other product names are trademarks of their respective owners.

The VoicePro+2 handles voice, voice-mail, fax and data calls on two separate phone lines simultaneously, while continuing to run your existing Windows™ applications. The VoicePro+2's internal 14.4kbps modem automatically manages your fax & data communications while an independent 16-bit, multimedia compatible audio section plays .WAV files, FM synthesized MIDI music, entertainment or CD audio. An on-board fax discriminator/switcher connects a second modem or existing plain-paper fax, allowing simultaneous 2-line transmission. Fax calls can be directed to either the internal modem or external device for added flexibility.

The VP+2 also provides unattended Caller I.D. and distinctive ring mailbox switching, adding extra versatility to each available phone line. Calls are routed however you desire, by ring type, by calling number, or both. PBX type switched "hook/flash" calls are directed and managed by the VP+2's Auto-Attendant features. Additionally, you'll get a Full-Duplex speaker phone\*, Voice & Fax Message Forwarding, Autodial Pager, full Fax-Back and Fax On Demand, and Message/Music on Hold.

No other system offers so much in one integrated, affordable package.

All of these features, plus easy upgrades to Remote Voice Recognition, Unattended Message Delivery and TAPI drivers for Windows '95 makes the VoicePro+2 the wise choice for your 2-line communications needs, both now and in the future. We also provide free technical support for the first 90 days and all the installation assistance you'll ever need.

Give us a call today and put the power of the VoicePro+2 to work for you! At a list price of \$329, the VoicePro+2 is the most versatile and powerful device ever plugged into a single slot in your computer.

Includes:

Teledapter VoicePro+2 Message Center (TM), SuperVoice (TM) and ESS AudioDrive (TM) software, cables and complete operating instructions.

\*External speaker & microphone optional.

Minimum requirements: 386-33mhz and Microsoft Windows 3.1 for 2-line operation.

**Teledapter Systems Inc.™**

Making The Pieces Fit

Sales: 1-800-997-PR02

Info: 1-512-392-6600

Fax-On Demand: 1-512-392-3991



# Come To The Source...

Who owns patents and maskworks on the **original** CMOS 6502 microprocessor?

No, it's not Rockwell. No, it's not NCR. These companies and over 30 others are licensees of The Western Design Center, Inc. - WDC is the **original source** of this valuable technology. This is the 20th anniversary issue of BYTE Magazine and WDC is pleased to be celebrating the 20th anniversary of the introduction of the 6502. The founder of WDC was at the St. Francis Hotel, San Francisco, in September 1975 where the 6502 was first sold for \$25 (**revolutionary** pricing).



- low gate count
- legendary instruction set!
- Core licenses Available -
- low license fee
- process independence
- Works with your proprietary bus. plan

The 65C02 technology had an interesting **beginning**...having been used in many **original** consumer and game products such as Commodore, Atari, Nintendo and the Apple II. The 6502 has now evolved into a family of compatible microprocessors and microcontrollers currently being used worldwide in products such as the Super NES, heart defibrillators, pacemakers, dashboard controllers, and set top cable converters, to name a few.

CHIPS →

- Power Management
- General Control Functions
- Standard product available direct from WDC -
- Jane call for price/delivery

MENSCH: Webster's -  
[Yiddish, from German]  
man, human being;  
a person of integrity.

WDC is continuing to evolve and is unveiling a system level product based on our proprietary technology. Our mission is to bring together the talents and creativity of individuals who recognize this product as a **paradigm shift**. We are looking forward to hearing from men and women who want to participate in the continuing pioneering efforts of WDC. We now look for something different as WDC unveils a new system - affectionately called...

The Mensch Computer

The Mensch Computer represents functionality with boundaries and limitations for digital messaging. This is a solid-state computer, a Model A for the information superhighway.



a folks-wagon  
for the Info-bahn!

SYSTEMS →

- e-mail
- Mensch mail
- digital messaging
- Industrial control/comm.
- Limited Quantities on Sale Now



The Western Design Center, Inc. • E-mail [wdesignc@indirect.com](mailto:wdesignc@indirect.com)  
2166 E. Brown Rd. • Mesa, AZ 85213 • 602-962-4545 • Fax 602-835-6442

All products and company names are trademarks or registered trademarks of their respective holders.



## The first true 32-bit client/server BBS – reserved for a few select MIS Managers.

Mustang Software's top secret project Wildcat! BBS re-write, code-named *Annihilator*, is now available to 5000 select MIS Managers, offering a glimpse of this breakthrough 32-bit client/server technology – from the manufacturer of the world's most popular BBS software. And when you purchase one of the limited Pre-Release *Annihilator* CDs for only \$49, you'll save 75% off the regular purchase price later this year.

### Interactive Multimedia Can Expand Your Company's On-line Experience

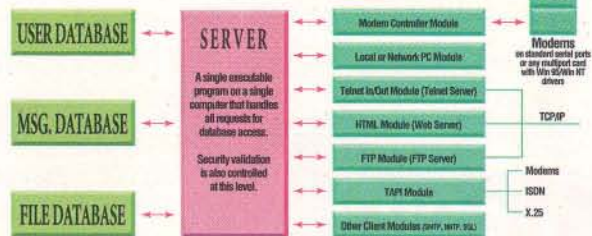
*Annihilator* blends Windows 95 multitasking, NT robust server operations, and MAPI technology, with BBS technology to offer full on-line multimedia to every caller. And you never have to retrieve the information. Whether it's sent from a node on your LAN, a remote location, or an address on the Internet, it all shows up right on your E-mail system.

### Deliver Even More Information – At Much Greater Speeds

*Annihilator's* Preview CD will show how the true power of client/server functionality can be unleashed to provide users with broad, BBS-based solutions. They'll learn how to implement a BBS with a core information server, and route that information using a number of application clients. And be able to establish a true distributed processing system that delivers more information at greater speed, even on a single PC.

Call today. Your copy of *Annihilator* is waiting.

### Single PC Running Windows 95 or Windows NT



The client/server model of *Annihilator* can be easily installed with the server and all clients running on a single PC. The computer can operate under Windows 95 or Windows NT Workstation or Server. This configuration offers the most compact system and allows for total management from the single BBS computer.

### Buy The Pre-Release *Annihilator* CD For \$49\* And Save Up To 75% Off The Purchase Price

Instructions and information on the Pre-Release *Annihilator* CD provides MIS Managers with an inside look into the future of BBS technology.

Purchase of the Pre-Release *Annihilator* CD establishes eligibility for a 75% discount off the manufacturers suggested retail price when *Annihilator* is released later this year.

Only 5000 Copies Of The Pre-Release *Annihilator* CD Will Be Mastered. Get The Inside Track And Stay On The Leading Edge Of BBS Technology By Getting Your Copy.

**Call Today To Reserve A Copy  
1-800-663-7509**

\*Add \$10 for shipping and handling



**Connecting The World**

Mustang Software, Inc. • 6200 Lake Ming Road • Bakersfield, CA 93306  
805-873-2500 • FAX 805-873-2599 • BBS 805-873-2400 • WWW: <http://www.mustang.com>

Although the BBS on the CD will be operational, it is not intended to be used as a commercial BBS because it will not have completed testing nor will it include full printed documentation. © 1995 Mustang Software, Inc. All names are trademarks of their respective companies.

# Lose 500 pounds in 10 minutes

**with a Rose keyboard monitor switch**



Call today for free catalog

- ◆ Print servers
- ◆ Data switches
- ◆ Keyboard/video control

**800-333-9343**

P.O. Box 742571 ◆ HOUSTON, TEXAS 77274  
TEL 713/933-7673 ◆ FAX 713/933-0044

Streamline your computer room by reducing excess equipment. Access up to 256 CPU's from a single keyboard, monitor, and mouse. ServeView is our best-selling switch, has every feature you can imagine, and installs in minutes. Compare price, features, performance, quality, and support and you'll find Rose can't be beat.

Call us to discuss your application or to receive your free information kit.





## NEW Copy Protection.....

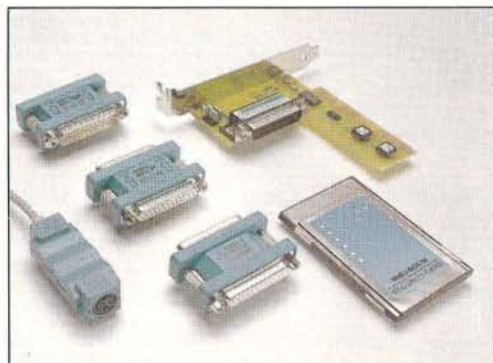


- ✓ WIBU-KEY – Secure against systematic "crackers"!
- ✓ WIBU®-BOX for LPT, COM, ADB, as card for (E)ISA slots and as PC-Card (PCMCIA Type II)
- ✓ WIBU-BOX is smallest ASIC based dongle!
- ✓ Protection for DOS, Windows and networks without requiring source code modification
- ✓ Windows™, Windows™95+NT, Mac™OS, OS/2®, Novell
- ✓ CD-ROM Install-Shield

Call now:  
800-986-6578

### WIBU-KEY

The most complete palette of copy protection hardware



Order your evaluation package today!



## WIBU-KEY

High Quality in Software Protection

**WIBU  
SYSTEMS**

WIBU-SYSTEMS GmbH  
Rueppurrer Strasse 54  
D-76137 Karlsruhe, Germany  
Phone: +49-721-93172-0  
FAX: +49-721-93172-22  
CIS: 100142,1674



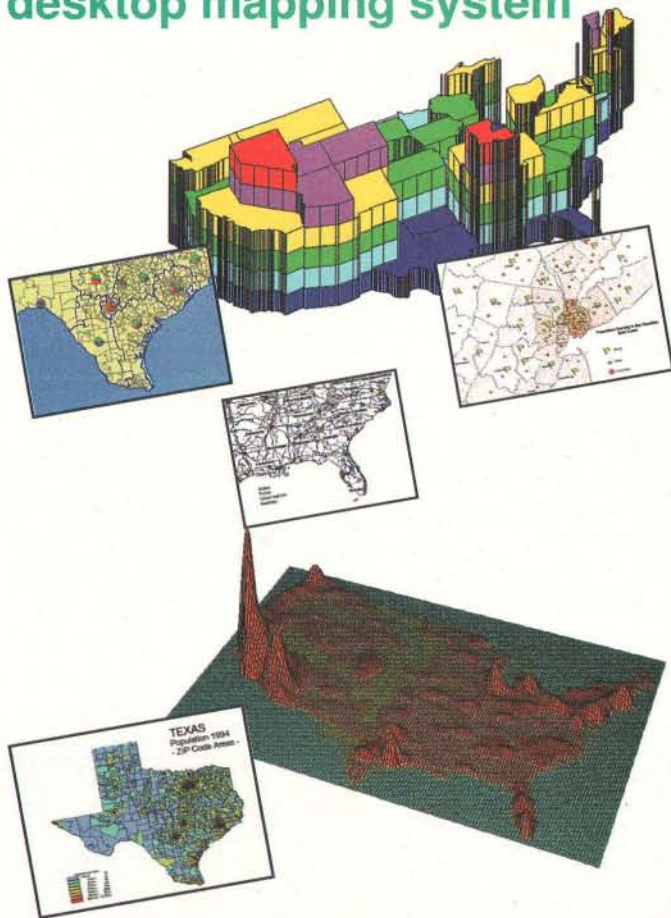
**EUROPEAN SOFTWARE  
CONNECTION**

1617 St. Andrews Drive, Lawrence, KS 66047  
Phone: (913) 832-2070, FAX: (913) 832-8787  
Techn.Supp.(913) 832-1623, CIS: 71141,3624

Circle 313 on Inquiry Card.

See your business data in a minute...

...with RegioGraph, the desktop mapping system



The powerful GIS technology for business is used in RegioGraph for professional presentation and reports, regional analysis, site selection, sales district planning, market delineation and controlling.

### Functions

Thematic mapping and shading; 2-D, 3-D pie charts, bar graphs; dot density maps; scaled symbol maps; 3-D prism and contour lines; portfolio technique; presentation of cross tables in maps; easy creation of sales territories; fast aggregation of maps and data; spatial selection and data filter in maps and data; geocoding of pointfiles (customers); unlimited number of layers; multimedia layer; ODBC/OLE; interface to SPSS; import capability of different graphic formats; digitizing module; high quality, scalable output.



MACON GmbH  
Schoenbornstrasse 21  
D-68753 Waghäusel, Germany  
Phone: +49-7254-983-0  
FAX: +49-7254-983-290

Circle 314 on Inquiry Card.

Companies from Baden-Württemberg, Germany together at COMDEX/Fall'95

### Kleinmann GmbH

Am Trieb 13, D-72820 Sonnenbuehl, Germany  
Phone: +49-7128-9292-0, FAX +49-7128-9292-92

### Computer Cleaning Products

Not for Endusers. Exclusive with private Label.

Circle 315 on Inquiry Card.



## PENTIUM MOTHERBOARD

With Built-In Adaptec SCSI-2/IDE Controller. Accommodates 75, 90 or 100MHz CPU's.  
3 PCI, 5 ISA Slots, 128Mb Allowable.  
Cooling Fan Included.  
**MB-P54AS \$419**  
Pentium Motherboard w/o CPU

## adaptec

**AHA-1542CF 16-Bit SCSI-2 Host Adapter (BusMaster) \$219**

**AHA-1542CFK Kit includes Adapter Card, OS Drivers & Cables \$285**

**AHA-2842VL 64 Bit SCSI-2 VL Bus Adapter Kit (Drivers, Cables, Adapter) \$269**

**AHA-2940KT PCI Local Bus SCSI BusMaster (RISC-based SCSI I/O) \$339**

## NETWORK MasterView

CPU Switch allows One Console to ACCESS Six Servers/CPUs. Cascadeable, built-in buffer, Auto-Scan/Manual Selection (3-40 sec. scan intervals), supports VGA to MultiSync. Perfect for access to File Servers, Troubleshooting or Routine Monitoring. LED indicators.

**CS-106 AT Only \$299**  
**CS-104 AT or PS2 \$279**

**VIDEO SEPARATOR** is a fast flexible solution for VGA duplication. Video Signal is enhanced for long distance broadcasting up to 210 ft. (Daisy Chainable)

**VS-104 4 to 1 \$129**  
**VS-108 8 to 1 \$189**

## CABLE ASSEMBLIES

\*Please fill in \* with length desired \*4 ft 10 ft

**Printer Cables**  
PPC301\* Parallel Printer Cable (DB25 to 36P) \$2.99 \$3.99

**DB-25 Line Cables** (Wired Straight Thru, Shielded w/Thumbscrews)

25MM\* DB25 Male to Male \$3.99 \$4.99  
25MF\* DB25 Male to Female 3.99 8.99

**Extension Cables** 1-9 10+  
5MM-6 D5P M to M (6 foot) \$2.99 \$2.54

KEC-6 Keyboard Cable (6 foot) 2.99 2.54  
PS2-KEC6 PS2 Keyboard Cable (6 foot) 3.99 2.99

PS2-KA AT Keyboard on PS2 (MDSP to D5P) 2.89 2.75

MEC-6 Monitor Extension Cable 2.99 2.44  
PS2-MEC6 VGA Monitor Cable (6 foot) 3.99 2.99

**AC Power Cords** 1-9 10+  
ACP-02 PC Power Cord, 10' \$2.49 \$2.23

ACP-03 Monitor Power Adapter, 1' 2.29 1.99  
ACP-04 Monitor Power Extension (6') 3.69 2.75

**Drive Cable Assemblies** Each  
HD-IDE 40S-40S Single IDE Hard Drive Cable \$1.49

DFC-U Universal Cable Set (5 Connector) 2.95  
2HDIDE Dual IDE Hard Drive Cable 2.99

YAD-4 Disc Drive "Y" Adapter 4P 1.99

**SCSI Cables**  
SCSI-RC Three IDS 50-Pin Sockets (2) \$4.95

SCSI-DC 50-Pin Cent (M) - 50-Pin Cent (M) 7.99

SCSI-HI 50-Pin Cent (M) - 50-Pin Half Pitch 29.95

SCSI-HI 50-Pin HP to 50-Pin Half Pitch (3) 29.95

SCSI-2H 50-Pin HP to 50-Pin HP (6) 34.95

SCSI-EC6 50-Pin Cent (M) - 50-Pin Cent (F) 9.99

**Gender Changers & Adapters** 1-24 25  
ATSCA 9P (F) to 25P (M) Adapter \$2.49 \$2.04

PC-SCA 9P (M) to 25P (F) Adapter 2.49 2.04  
TGC-9 9P Ultrathin Gender Changer 2.89 2.45

TGC-25 25P Ultrathin Gender Changer 2.99 2.75

**LINE EXTENDERS/BUFFERS**

**Non-Powered Parallel Line Extender** safely transmits data up to 1300 ft. over 4Pair phone line without data loss. Compact, FCC Approved. 30' cable

**PLE100 DB25 M to DB25 M \$49**

**PLE110 DB25 M to 36 Pin Cent. M 49**

**IC-9V200 9V/200mA, AC extends to 200' 6.25**

**AUTO SWITCH/BUFFER** - Powered Auto Switch with a optional Buffer Card. Takes data at full speed, cutting wait time.

**AS-411P 4 to 1 Parallel \$79**

**AS-811P 8 to 1 Parallel 119**

**AS-251P 2 to 1 Parallel (Compact) 25**

**AS-451P 4 to 1 Parallel (Compact) 49**

**AS-RAM-256K 256K Ram Buffer \$59**

**AS-RAM-1M 1 Mb Ram Buffer 129**

**AS-RAM-2M 2 Mb Ram Buffer 215**

**IC-9V300 9V/300mA, AC Adaptor 6.25**



# Altex Electronics

1-800-531-5369

10731 Gulfdale • San Antonio, TX 78216  
210-828-0503 • FAX: 210-340-2409  
Hours 8am-6pm M-F, 9-5pm Sat CST

11342 IH-35 North • San Antonio, TX 78233  
210-637-3200 • FAX: 210-637-3264  
Hours 8am-8pm M-F, 9-5pm Sat CST

10705 Metric Blvd. • Austin, Texas 78758  
(512) 832-9131 • FAX: (512) 835-1328  
Hours 8am-6pm M-F, 9-5pm Sat CST

15207 Midway Road • Dallas, Texas 75244  
(214) 386-8882 • FAX: (214) 386-9182  
Hours 8am-7pm M-F, 9-5pm Sat CST

TERMS: For C.O.D. orders add \$5 per package. Minimum \$25. Cash or Cashiers Check only. For orders under \$99 add \$3 handling charge. Orders \$99 or more no handling fee. All shipping is FOB San Antonio, Texas and will be added to your invoice. Texas residents add 7.34% sales tax. All returns require RMA# and must be returned in original condition. A 15% restocking fee will be assessed on product returned in non-resalable condition. No returns on memory, out cable or custom cable assemblies. Prices subject to change without notice. We are not responsible for typographical errors.  
**CORPORATE, INSTITUTIONAL & GOVERNMENT POs WELCOME. NET 30 TERMS AVAILABLE UPON APPROVAL.**

## NETWORKING

**NITC 10BASE-T/BNC Adapter Card** features software selectable I/O, interrupt & PROM address (Jumperless). NE2000/IEEE 802.3 compliant with LED indicators for activity & link detection. Supports NOVELL, Microsoft, Arisoft, FTP and PC/NFS. Compatible with all Bus systems, 10Mbps transfer & is FCC certified.

300-017-01	10BaseT/BNC Adapter (8/16bit)	\$39
400-006-01	16-Port 10BaseT Hub	\$264
400-004-01	8 Port 10BaseT Hub	\$135
700-003-01	Ethernet Bundle Pak (8Port Hub and 4 Combo Cards)	\$249

**BOCA 16-Port Ethernet 10BASE-T Hub** With 10Base-2 and AUI connections. Automatic partitioning upon excessive collision detection with automatic restoration upon correction. Compact, fits easily on a desktop. Includes AC adapter, BNC-T Conn and 5 Yr Mfg Warranty.

BEN220	BOCA 16-Port Ethernet 10Base-T Hub	\$264
BEN210	BOCAHUB-8 (Eight Port) 10Base-T Concentrator	\$135
BE2000/2	BOCA 10BaseT/2 Adapter Card	\$67
BEN120	BOCALANcard Combo Plug & Play (16-bit) RJ45 & BNC	\$70
BEN110	BOCALANcard TP Plug & Play (16-bit) RJ45 Only	64
BEN1VL	BOCALANcard VLB Plug & Play (32-bit) RJ45 Only	73
BEN1P1	BOCALANcard PCI Plug & Play (32-bit) RJ45 & BNC	83

**ETHERNET ADAPTER CARDS** are NE-2000/NETBIOS compatible, CSMA/IEEE802.3 protocol, distributed bus, 10Mbps, supports PC-LAN, MS-NET, NOVELL, built-in high performance transceiver drivers for ODI, NDIS, SCO UNIX, TCP/IP and has 8 IRQs for flexibility and on-board ROM socket.

LCS-8634MI	16-Bit NE2000 Ethernet Adapter (BNC, SGL Chip)	\$34
LCS-8634LT	16-Bit Ethernet Jumperless Adapter. (RJ45 Only)	36
LCS-8634TBA	16-Bit Ethernet Adapter (AUI, BNC, TP Conn.)	48
LCS-8934TBA	32-Bit Ethernet Adapter. (AUI, BNC, TP Conn.)	109
LCS-8834-2	PS/2 Ethernet Card (AUI/Cheaper Port, 800 meters)	140
LCS-8837-T	Transceiver 10Base-T (AUI to RJ-45) 5 Yr Mfg Warranty	\$42
LCS-8837-3	Transceiver for BNC Connector 5 Yr Mfg Warranty	\$62
LCS883R-T8	8 Port 10Base-T Repeater (AUI, BNC, TP)	\$149
LCS883R-2	12 Port Repeater w/2 Transceivers	189

**3COM Etherlink III "Parallel Tasking" 16-Bit 10BASE-T Network Adapter.** SNMP Manageable designed for ISA or EISA base boards. Includes User Guide and AutoLink Software diagnostics and drives.

3C509B-TP	10BASE-T 16-Bit Ethernet Adapter (RJ-45)	\$139
3C509B	10BASE-T 16-Bit Ethernet Adapter (BNC)	\$149
3C509B-TP	10BASE-T/2 16-Bit Ethernet Adapter (RJ-45/BNC)	\$139

## CATEGORY 5 VOICE/DATA CABLE

	1-99'	100-999'	1000'
VDC5-4	Level 5, 4 Pair, Unshielded CL-2 PVC	\$0.16	\$0.11
VDC5-4P	Level 5, 4 Pair, Plenum	0.50	0.38
MP-8S	8-Pin RJ45 Plug (Solid)	0.38	0.30

## POWER PROTECTION

**BC "Personal" & "PRO" Battery Back-Up Systems** provide excellent basic power protection, guards against blackouts/brownouts, surges or spikes thus saving data and hardware! Designed for Home or Small Office application. Features micro-processor controlled "Pulse Width Modulated Waveform" for increased backup time. \$25K Ultimate and 2 Yr Mfg Warranty.

BCPERS-280	280VA/175W Personal UPS (2 Outlets)	\$104
BCPERS-500	500VA/350W Personal UPS (4 Outlets)	181
BCPRO550	550VA/375W LAN UPS (4 Outlets)	197
BCPRO850	850VA/570W LAN UPS (4 Outlets)	305
BCPRO1400	1400VA/990W LAN UPS (6 Outlets)	446

## OMNIPRO LINE INTERACTIVE UPS

Designed for the Poor Power (Voltage Sags/Brownouts) Environment. Combined Line Interactive Technology and New Microprocessor Controlled standby UPS (On-Board UPS Voltage Regulator) design keeps your computer working through extended brownouts without draining battery power. Line

Interactive voltage correction from 91 to 140 AC, back to 120V nominal. Offers Pulse Width Modulated Output, Spike and RFI/EMI filtering, 5 second restart delay, automatic inverter shutdown and Ultimate Lifetime Insurance.

Part#	Output (Volts/Watts)	NEMA5-15R Outlets	DB9 LAN Port	Backup Time (Half Load)	Lbs	Each
OMNIPRO280	280/175	4	No	17	13	\$149
OMNIPRO450	450/280	4	Yes	17	15.5	207
OMNIPRO675	675/425	4	Yes	17	20	279
OMNIPRO850	850/570	4	Yes	21	27	369
OMNIPRO1050	1050/705	6	Yes	23	32	414
OMNIPRO1400	1400/940	6	Yes	24	39	499

# Happy 20th BYTE!

## BOCA RESEARCH INC

## 28.8KBPS V.34 MODEMS

MV.341	28.8Kbps Internal	\$174
M1440E	14.4Kbps External	106
MV.34E	28.8Kbps External	225
SE1440	14.4Kbps Modem, VoiceMail, Speakerphone	169
M1440I	14.4Kbps Internal Modem & Sound Card	82

## MEMORY

1MEGX9-70	\$47
4MEGX9-60	199
4MEGPS2-60	197
4MEGPS2-70	194
8MEGPS2-60	385
16MEGPS2-60	698
1MEGX1-70	7.00
44256-70	7.00

Call for Current Pricing

## BOCA "Voyager 64"

High Speed Graphics Accelerator to 1600 x 1200 resolution PCI Bus, 2Mb DRAM, "Green PC Savings".

**SVGP64**  
**Voyager 64 PCI 2Mb Accelerator \$199**

## CATEGORY 5

19" Patch Panels With 110 Blocks  
Part # Desc. 1-4 5-9 10+  
PPB24-5 8 Wire, 24 Port \$99 \$96 \$89  
PPB48-5 8 Wire, 48 Port 209 194 181  
PPB96-5 8 Wire, 96 Port 399 372 347

**CATEGORY 5 (100Mbps Standards)**  
Colored Cable ONLY (No Boot)  
\* Simply fill in \_\_\_\_\_ with one of following cable colors desired:

70 (Gray)	73 (Green)	71 (Black)
74 (Red)	72 (Blue)	75 (Yellow)
Altex No. Length	1-9 10-49 50+	
73-66 -3 3 ft	\$4.00	\$3.56 \$3.20
73-66 -7 7 ft	5.25	4.67 4.20
73-66 -15 15 ft	7.80	6.93 6.24
73-66 -25 25 ft	11.03	9.80 8.82
73-66 -50 50 ft	18.25	16.22 14.60

Wall Plates for Inserts 1- Ivory W-White  
Part # Description 1-9 10-24 25-99  
KWP-1 1 Port \$1.49 \$1.34 \$1.22  
KWP-2 2 Port 1.49 1.34 1.22  
KWP-3 3 Port 1.49 1.34 1.22  
KWP-4 4 Port 1.49 1.34 1.22  
KWP-6 6 Port 1.49 1.34 1.22

110 Type RJ45 Jack INSERTS  
Available Colors: Ivory, Black, Red, Green, Yellow, Orange & Blue

KJ-110WH	White	\$5.50	\$5.00 \$4.58
Other Type Inserts	I-Ivory W-White		
KP-IN	Blank Insert	\$0.30	\$0.25 \$0.20
KP-INW	Blank Insert	0.30	0.25 0.20
KP-BNC	BNC Feed through Insert	3.00	2.73 2.50
KP-BNCW	BNC Feed Thru Insert	3.00	2.73 2.50
KP-ST	ST Insert	6.50	5.91 5.42
Wall Plate Mounting Boxes			
MB-IV	Ivory	\$2.50	\$2.27 \$2.08
MB-WH	White	2.50	2.27 2.08

## HARD DRIVES

**IDE Seagate**  
ST-3491A 428Mb @ 15ms IDE \$189  
ST-3650A 545Mb @ 14ms IDE 209  
ST-3780A 722Mb @ 12ms IDE 289  
ST31220A 1.08Gb @ 9ms IDE 349

**SCSI Seagate**  
ST31230N 1.05Gb @ 9ms \$629  
ST32550N 2.14Gb FCSI BARRACUDA 1,149  
ST15150N 4.0Gb FCSI BARRACUDA 1,649  
ST410800N 9Gb FCSI BARRACUDA 2,899

## Maxtor

MXT-7420A	420Mb @ 14ms	\$189
MXT-7540A	540Mb @ 12ms	209
MXT-7850A	850Mb @ 14ms	259
MXT-71050A	1.05Gb @ EIDE	319
MXT-71260AT	1.2Gb @ 12ms	349



# GRAPHIC TOOLS

Available on DOS, MS Windows, Windows NT, OS/2 PM, SCO Unix, Interactive Unix, Solaris on Intel and SUN SPARC. Your applications written with the GSS Graphic Tools are portable to all platforms.

32 bit technology also on DOS through support of PharLap DOS extender, Lahey Fortran LF90, Watcom C, Watcom Fortran, MS Visual C/C++, MS Fortran Powerstation and Metaware High C/C++.

## GSS\*GDT

### CGI-Standard

**Graphics Development Toolkit** enables you to develop applications in a device and system independent way. Based on the ISO CGI standard GSS\*GDT supports a variety of input and output devices through device-specific CGI drivers. GSS\*GDT is completely integrated into the underlying windowing system and comes with more than **160** callable C and Fortran functions. Furthermore, it is compatible with the **Graphics Development Tools** from IBM and SCO.

## CGM

### CGM-Standard

**Computer Graphics Metafile** is the ISO/ANSI standard for system independent storage of vector and rasterbased graphical information. CGM is part of the worldwide CALS and ATA initiatives that optimize industrial processes and is implemented in hundreds of applications. Together with our partner, Henderson Software Inc., whose president Lofton Henderson is the technical editor of the CGM standard, EMATEK offers a complete product line of CGM tools.

**MetaGen:** The C function library to generate standard compliant CGM metafiles.

**MetaTran:** The C function library to interpret CGM metafiles.

**MetaCheck:** The tool to check CGM metafiles for standard conformity.

**MetaPrint:** CGM printer driver for MS Windows.

**HSIview:** Metafile Interpreter for MS Windows and CGM/WMF Converter.

**GSS\*CGM:** The high level C and FORTRAN function libraries to interpret and convert CGM metafiles via GSS\*GKS and GSS\*GDT.

## GSS\*GKS

### GKS-Standard

**Graphical Kernel System** is a C and FORTRAN function library that enables you to develop portable graphic applications which include for example user interaction, coordinate transformation and object segmentation, based on the ISO GKS Standard. GSS\*GKS, which is installed in large quantities on the DOS platform and has been proved successful for years, is now available for the graphical user interfaces and therefore offers the software developer a smooth transition to the new windowing systems.

## CGI Print Manager for X11

Windows NT shook the UNIX community decently. But on closer examination it is the numerous small features which make NT attractive and which the UNIX system does not possess. For example the Windows Graphical Device Interface (GDI) is one of these features and allows every hardware manufacturer to develop device drivers and to deliver them with his devices. Hence every customer can, at any point, install additional drivers himself thus optimizing the use of his software. Up until now this is impossible under UNIX. But EMATEK has just developed a print manager for Motif/X11 on the base of the Computer Graphics Interface (CGI) standard. The final product will allow each X11-based application to address printers, plotters or output files through the CGI device interface. In addition, CGI as an ISO standard adheres to the UNIX open systems' philosophy.

## GSS\*EasyChart

This brandnew library for MS Windows provides you with functions to easily integrate business charts and graphs into your application. For an incredibly low price you can view your datasets as pie, bar, line, step or schedule charts and customize each detail. Enhance your existing application with presentation graphics capabilities. Business Charts and Graphs supports various C and Fortran compilers.

## Training & Consulting

Our training & consulting group deals with a variety of activities ranging from customer consulting to training in the use of graphical standards as well as designing and developing graphical solutions.

Circle 317 on Inquiry Card.

15 Years  
**EMATEK**

Ematek GmbH  
Subbelrather Strasse 17 · D-50823 Cologne, Germany  
Phone: +49-221-512074 · Fax: +49-221-529666

Email: [gsscgi@ematek.de](mailto:gsscgi@ematek.de)



A sign of Quality for over 12 Years



# When disaster strikes your computer, be prepared with advanced technology from MICRO 2000...

**A**LL COMPUTER EQUIPMENT will eventually fail. It may take years before your hard drive crashes. It may be months before you have any serious data loss, problems with your memory or experience chip failure. Then again, it could be today!

At MICRO 2000 we are constantly thinking ahead to provide you with the products you'll need to protect yourself from hours of frustration and downtime. Our expanding line of products can assist you to recover data from a crashed disk when all the others have failed.

We can help you diagnose what's wrong with your PCs in a flash, on-site or remotely—without a modem!

## ***Tech Support you can count on in the crunch...***

Good products are one thing, but how about someone to walk you through the tough stuff? Even though a large percentage of our clients are professional technicians and power users, we regularly receive calls from beginning users who need help getting started. After all, these are tomorrow's power users and technicians.

## ***Advanced technology based on what you need...***

You can help us to serve you. If you use any of our products, please let us know what you like about them, or what improvements we could make. We try to make each new version fulfill as many needs and wishes as possible, as your business and success are important to us. Give us a call or write to us with any comments.

**MICRO  
2000**

**Call 1-800-864-8008**



**THIS IS A MUST-HAVE TOOL** for PC Service Technicians everywhere. Supply your customers with this inexpensive software and let MICRO-SCOPE CLIENT diagnose what's wrong with their PCs without leaving your office!

When your customer calls you with a service problem, simply have him boot his PC with the Micro-Scope CLIENT floppy disk in drive A and select either the Quick Test or the Extensive Test. Then just look up the resulting error codes in the CLIENT manual and you'll know exactly what's wrong and be able to bring the correct replacement chips, drives, cables, etc. CLIENT also reports the exact system configuration so you can insure compatibility. Saves time and money!



**MICRO-SCOPE CENSUS LETS YOU** keep track of hundreds or even thousands of computers and know each one's exact hardware and system configuration at a glance. Many technicians and MIS Directors use this

software tool to save hours of downtime in companies with multiple computers.

Simply load the supplied disk into each computer on site (up to 100 PCs recordable on each disk). CENSUS automatically records complete system information and assigns each PC a unique ID number. The data can now be downloaded from the disk into any database program so it's ready to retrieve at a moments notice. For even greater productivity and speed, use CENSUS in combination with MICRO-SCOPE CLIENT to remotely diagnose each PC and arrive with the exact parts required, fully compatible. You'll be in and out in a flash with a greater profit margin.



**QUITE OFTEN THINGS AREN'T** what they seem. The rated speed and efficiency of a computer can be misleading—and sometimes absolutely false. You should know exactly what you're getting for your money!

Imagine walking into a computer store, pulling out your **COMPUTER CONSULTANT** diskette, placing it into the A drive of a computer and having detailed, 100% accurate information about the PC. In a matter of minutes you could test every PC in the store, and knowing the exact configuration of each, determine which one was best for your needs without all the sales hype. That's what **COMPUTER CONSULTANT** can do for you.



**AT LAST—EXTENSIVE AND FOOLPROOF** data recovery for everyone! The only comparable service to 911-RECOVER is a professional data recovery company, which could take several weeks and cost you hundreds or thousands of dollars.

Avoid the downtime and worry by using 911-RECOVER right in your own office. 911-RECOVER reads right down to the bit level even if the directories and File Allocation Tables are damaged. It can recover data that has been damaged by other "recovery software." Does not need DOS intact to function. If the data is physically on the drive, it *can* be recovered.



# What to do when your PC coughs, wheezes and/or dies...

## the **UNIVERSAL DIAGNOSTICS TOOLKIT**

Works with any PC & Operating System!



Call Now for Information on Special Pricing:

# 1-800-864-8008

Or Fax (818) 547-0397



1100 East Broadway, Suite 301, Glendale, California  
Phone 818/547-0125 • Fax 818/547-0397

International Orders please call:

Micro 2000 Australia: 61-42-574144

Micro 2000 Europe (UK): 44-462-483-483

## Micro-Scope 6.0

UNIVERSAL DIAGNOSTIC SOFTWARE

New  
Version  
Release

**Fully O/S independent  
diagnostic software...**

*Call for upgrade pricing &  
complete new features list!*

**M**ICRO-SCOPE Universal Computer Diagnostics was developed to satisfy the expanding need for accurate system diagnosis in the rapidly growing desktop computer market. Patterned after super-mini and mainframe diagnostic routines, **MICRO-SCOPE** runs independently of any standard operating system, and is therefore at home on any machine in the Intel world. Speed, ease-of-use, and razor sharp accuracy are a few of the advantages that arise from this system independence. Jerry Pournelle awarded MICRO-SCOPE & POST-PROBE the User's Choice Award in the May 1994 issue of Byte Magazine: "You name it, this tests it. If you maintain PCs you'll love it."

- ◆ **LOW-LEVEL FORMAT**—Performs Low-level format on all drive types including IDE drives. This function cannot hurt IDE drives.
- ◆ **USE CONTROLLER BIOS**—Program will access BIOS format built into any hard disk controller—even Controllers yet to be invented.
- ◆ **O/S INDEPENDENT**—Does not rely on O/S for diagnostics. Talks to PC on hardware level. All tests are full function regardless of O/S (i.e. Novell, UNIX, OS/2).
- ◆ **TRUE HARDWARE DIAGNOSTICS**—Accurate testing of CPU, IRQ's, DMA's, memory, hard drives, floppy drives, video cards, etc.
- ◆ **BATCH CONTROL**—All tests, even destructive, may be selected for testing.
- ◆ **ERROR LOGGING**—Automatically inputs errors during testing to an error log.
- ◆ **AUTOMAPPING**—Automatically bad sector maps errors found on hard disks.
- ◆ **IRQ DISPLAY**—Show bits enabled in IRQ chip for finding cards that are software driven. (Network, Tape Backup, etc.)
- ◆ **IRQ CHECK**—Talks directly to hardware and shows I/O address and IRQ of devices that respond.
- ◆ **MEMORY EXAMINE**—Displays any physical bit of memory under 1 Meg. Very useful for determining memory conflicts. Very useful for determining available memory space.
- ◆ **SECTOR EDITOR**—Allows the editing of any sector of floppy or hard disk media (even track 0).
- ◆ **AND MUCH MORE...**—We don't have enough space here for everything this software can do!

## Post-Probe

First Ever Universal P.O.S.T. Card for All PCs!

**The only Power-On Self-Test card you need  
to debug any "dead" PC...**

"This is the only card that will function in every system on the market. The documentation is extensive, and not only covers the expected POST Codes for different BIOS versions, but also includes a detailed reference to the bus signals monitored by the card." —**Scott Mueller** from his globally recognized book, *'Upgrading & Repairing PCs, Second Edition'*

- ◆ Includes pads for voltmeter to attach for actual voltage testing under load.
- ◆ 4 LEDs monitor +5vdc -5vdc +12vdc -12vdc.
- ◆ Monitors Hi & Lo clock and OSC cycles to distinguish between clock chip or crystal failure.
- ◆ Monitors I/O Write and I/O Read to distinguish between write and read errors.
- ◆ Monitors memory write/read to distinguish between address line failures and memory chip failures.
- ◆ Monitors ALE for proper CPU/DMA operation.
- ◆ Monitors Reset to determine if reset is occurring during POST, indicating short.
- ◆ Monitors progress of POST without POST codes.
- ◆ Reads POST codes from any IBM or compatible that emits POST codes. ISA/EISA/MCA.
- ◆ Compatible with Micro Channel computers.
- ◆ Dip switch allows easy selection of I/O ports to read.
- ◆ Includes tri-state **LOGIC PROBE** to determine actual chip failures.
- ◆ Manual includes chip layouts and detailed POST procedures for all major BIOS's.
- ◆ **AND MUCH MORE...**—call for more details.



Govt. Serv. #: GS-00K-94AGS-5396

Circle 301 on Inquiry Card (RESELLERS: 302).



**Rock 'n' Roll is big business with a need for powerful software solutions.**

# DATA FLEX<sup>®</sup> MEANS BUSINESS

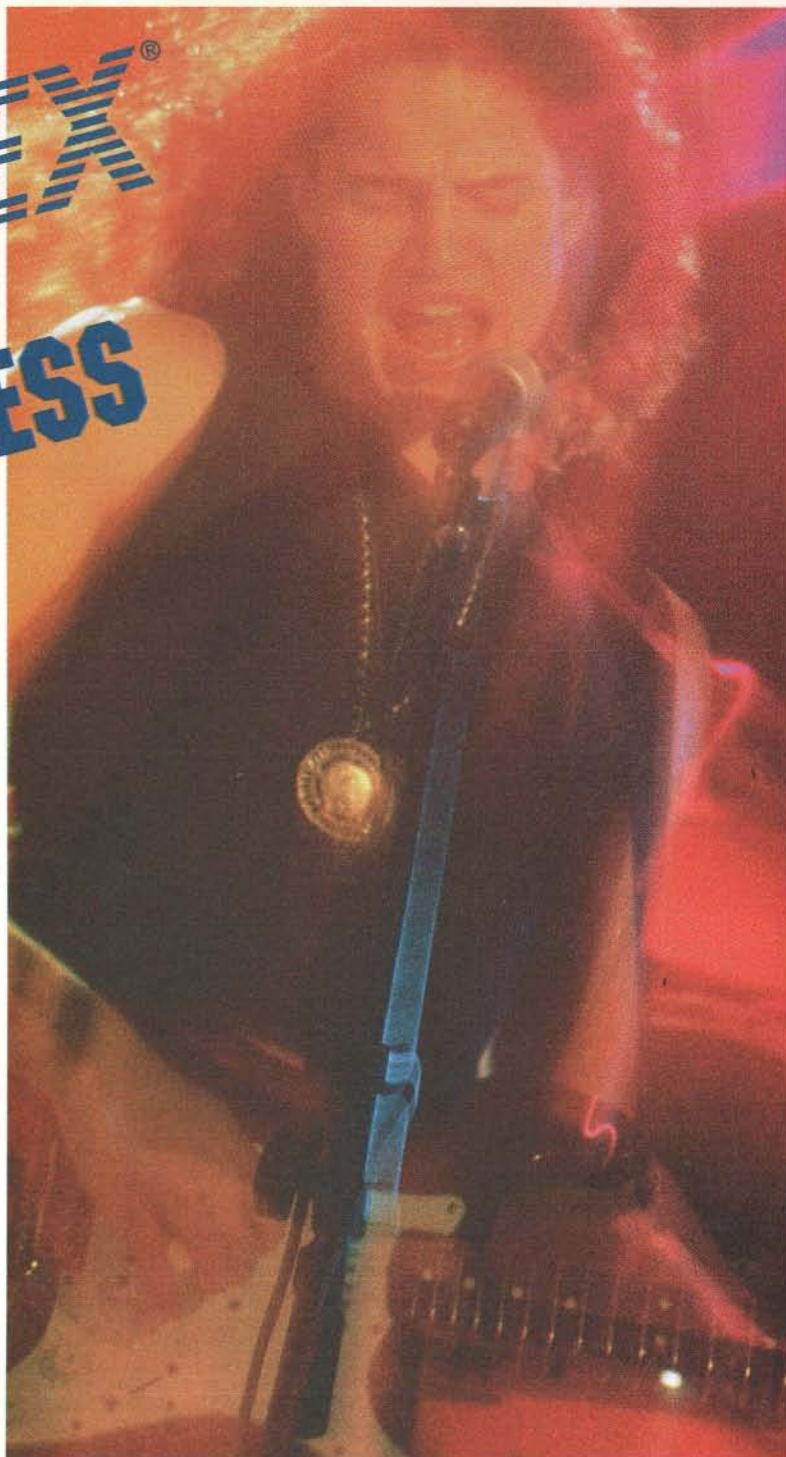
When you choose the DataFlex application development system, you can count on delivering powerful solutions. DataFlex's greatest strength is in the language, a 4GL strong enough to sustain anything you can build on it. Powerful enough to take you far beyond the point at which most other products leave you stranded.

Over 350,000 installations and 2,000,000 users in 40 countries make DataFlex a proven solution for a wide range of business applications for companies like Mercedes-Benz, Coca-Cola, and the Rock and Roll Hall of Fame.

*"DataFlex's greatest strength is in the language itself. I like knowing my customers, from the Pittsburgh Symphony to the Rock and Roll Hall of Fame, can depend on their DataFlex-based applications to manage their very hectic schedules. I, as the developer, can focus on the business requirements of the application, rather than the underlying language capabilities and systems."*

**Randy Slapnicka**  
Event Software Corp.

DataFlex means business. We speak your language because we want you to speak ours. Call us today for a free information kit.



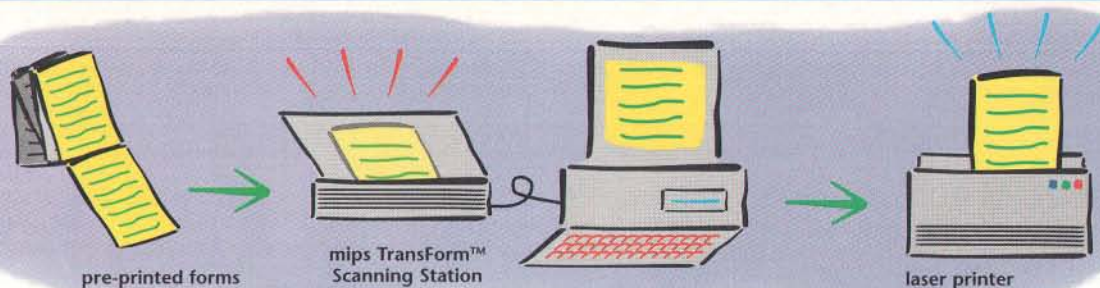
## In the United States, Phone 1-800-451-3539 For Sales Information

Country	Telephone	Fax	Country	Telephone	Fax
Eastern Australia	(61) (03) 888-9899	(61) (03) 888-9950	Malta	356-241246	356-230631
Western Australia	(61) (09) 321-3378	(61) (09) 481-1874	Mexico	(525) 631-4663	(525) 631-4538
Brazil	(55) (011) 872-9266	(55) (011) 653-899	Netherlands	(31) 074-55 56 09	(31) 074-50 34 66
Canada	416-226-2181	416-226-4341	Poland	(48) 42-334139	(48) 42-746434
Germany	(49) 06172-9568-0	(49) 06172-956812	Spain	(34) (1) 372-95-17	(34) (1) 372-81-56
Greece	(30-1) 6517945	(30-1) 6536891	Thailand	(66) (02) 276-2559	(66) (02) 275-9156
Italy	(39) (0184) 231.606	(39) (0184) 231.243	Trinidad	(809) 628-9330	(809) 628-9259
Japan	(81-3)-3296-7324	(81-3)-3296-7329	United Kingdom	44 (1-923) 242222	44 (1-923) 249269

**DATA ACCESS**  
CORPORATION

CompuServe: GO DACCESS - Internet (WWW): <http://www.daccess.com>





## Now, Go From Paper To Electronic Forms Automatically.



**Introducing Transform™** As incredible as it sounds, you can now scan your paper forms into fully editable, electronic forms in minutes.

Thanks to its artificial intelligence, Transform senses boxes where data is entered and lets you type into them directly. Each form you create with Transform can be filled or merged with variable data, E-mailed and faxed. What's more, all your forms can be filled and printed from nearly

any computer platform. ■ Another benefit: with Transform, you can quickly make changes to forms at any time and print out new forms when you need them. No more throwing away stacks of obsolete forms! ■ And for convenient form storage, our mips FormShuttle™ and SmartSimm™ use flash memory to hold up to 200 forms and insert right into your laser printer. Since forms stay printer-resident they'll print much faster. ■ Find out more today: **800-898-8560**

**Call the mips authorized dealer near you.**

**DocuPrint, Sweden:**  
46-8-283390

**mips Technologies GmbH,**  
Germany: 49-6127-3845

**DOMINION BLUELINE, Inc.**  
Canada: 1-800-561-1237

**Patriot Group, Houston, Dallas**  
San Antonio, TX 1-800-753-0781

**PC:\Forms>Inc., Wisconsin:**  
1-800-786-8827



**Dataline America, Inc.**

(619) 679-4070 • Fax (619) 679-4073

## LASER INKJET COMPUTER CHECKS

CONTINUOUS FEED CHECKS AND CHECK SAVERS ALSO AVAILABLE

**AS LOW AS \$24.95**

**CALL: 1-800-239-4087**

FAX ORDERS: 1-800-774-1118  
(PLEASE CALL FOR A FAX ORDER FORM)

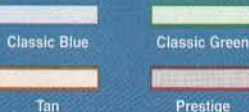
- ✓ QUICKEN
- ✓ SIMPLY MONEY
- ✓ MICROSOFT MONEY
- ✓ MANY MORE!

LASER AND CONTINUOUS FEED CHECKS AVAILABLE IN:

- ✓ BUSINESS SIZE
- ✓ BUSINESS SIZE with Voucher
- ✓ WALLET SIZE

Available in Singles and Duplicates.

**Choose From 4 Stylish Colors!**



**Designer™**  
CHECKS

**MC, VISA & AMERICAN EXPRESS ACCEPTED**

### How to Order

1. Enclose reorder form or voided check from existing check supply, noting any changes.
2. Include deposit slip from existing check supply.
3. Enclose payment check.
4. All orders will be shipped within 7 working days.
5. Complete the order form and mail with items 1, 2, & 3 to:  
**Designer Checks • P.O. Box 13387 • Birmingham, AL 35202**



### ORDER FORM

P09204B5  
BYTE

Software: \_\_\_\_\_ Version: \_\_\_\_\_

Start my checks with number: \_\_\_\_\_  
(if not given 1001 will be used)

☐ Singles ☐ Duplicates (call for prices)

Pick **ONE** Color: ☐ Classic Blue ☐ Tan ☐ Classic Green ☐ Prestige

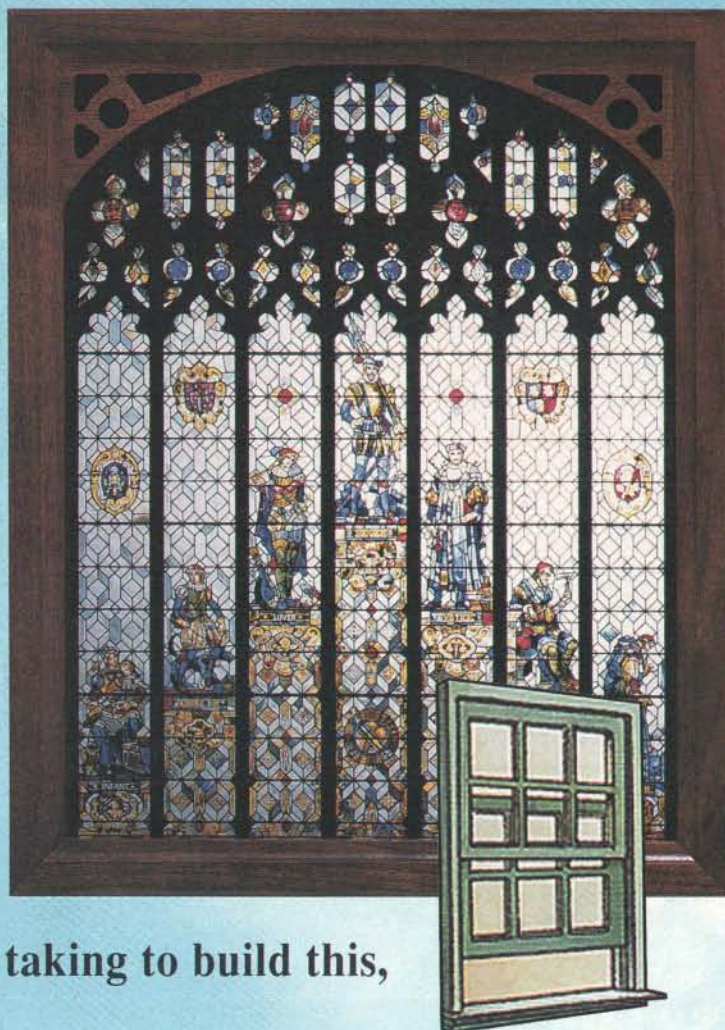
Laser/Inkjet Checks	250	500	1000	2000
Business Size	\$29.95	\$44.95	\$59.95	\$88.95
Business Size w/voucher	\$39.95	\$57.95	\$79.95	\$128.95
Wallet Size	\$24.95	\$39.95	\$63.95	\$89.95

Continuous Feed Checks	250	500	1000	2000
Business Size	\$26.95	\$39.95	\$57.95	\$89.95
Business Size w/voucher	\$29.95	\$42.95	\$64.95	\$99.95
Wallet Size	\$26.95	\$39.95	\$59.95	\$89.95

Shipping & handling	\$ 5.00
Shipping & handling by AirBorne add \$2.50	\$
Subtotal	\$
Alabama residents add 8% sales tax	\$
<b>TOTAL AMOUNT</b>	\$



*To create this...*



in the time it's taking to build this,

*use this.*

**CLARION**  
FOR WINDOWS™

Introducing Clarion for Windows™, the only Rapid Application Development environment and programming tool that delivers the promise - Productivity, Performance and Maintainability - for both 16 and 32 bit applications.

**You're More Productive** - because you write less code than other RAD tools. Any visual design tool can draw a user interface object. But Clarion's templates generate the functionality behind the objects, creating not just a button but a business solution, such as a look-up or a record update.

**Your Applications Fly** - because Clarion delivers a higher level of performance! Our optimizing compiler creates applications that perform tens of times faster than Visual Basic™ or Power Builder™ applications. And, going from prototype to application is quick and easy. Your end users will love it!

**Maintenance is Simplified** - because only Clarion's development environment is designed to cut the time needed for long-term maintenance. Change an option in the data dictionary, such as a Referential Integrity constraint, and your application is automatically updated, evolving to meet your end users' needs. Plus, Clarion is an expressive, compact language that's easy to learn and read.

Better. Faster. Smarter. That's Clarion for Windows. Call today for a **FREE TRIALPAK CD** and let us prove that Clarion delivers what it promises.

**TopSpeed**  
CORPORATION

**1-800-226-0734**

Copyright© 1995 TopSpeed Corporation. All products and company names are trademarks or registered trademarks of their respective owners.

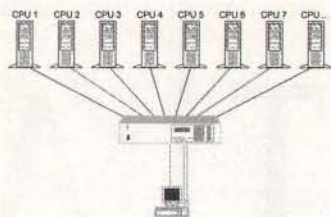
**Circle 343 on Inquiry Card.**



## Examples of Multi-Server-Network-Centers

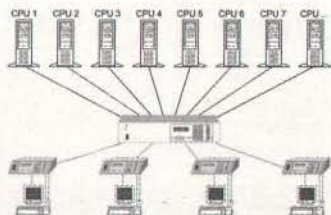
### Single access system

- Basic units available for 2\*, 4, 8, 12, 16, 24, and 32 CPUs
- Remote control optionally
- distance up to 328 ft (100 m)
- high quality video at high resolution and refresh rate
- mixed use of serial and PS/2 mice within one single unit
- microprocessor-controlled keyboard and mouse emulation for error-free booting



### Multi access system

- Basic units available for 8, 16, and 32\* CPUs
- access from consoles on up to four locations to many CPUs without interfering each other (real matrix)
- all features of the single access system build in



TBA

*The only recommended system by CompuServe Inc. and Microsoft C.E.!*

## MultYcon

#### See us at:

Networks Expo, Dallas  
Network & Interop, Atlanta  
Systems, Munich (Germany)  
Comdex Fall, Las Vegas

Distributors and system integrators worldwide welcome!

#### North America:

ELSNER Technologies Company  
5020 Mark IV Parkway  
76106 Fort Worth Texas  
Tel.: 1-800-243-2228  
Fax: 1-817-626-5330

Mail: CompuServe 75457,1377

#### International (Germany):

PolyCon Data Systems

Tel.: +49-5204-9134-21

Fax: +49-5204-9134-22

Mail: CompuServe 100020,1571



## ONE FOR ALL

and all on one



1024 CPUs under control using the

## MultYcon Console Switching and Management System

Save monitors, keyboards, and mice!  
Save administration costs, hardware, office fixtures, energy, and space!

## INTERCON - NETPRODUCTS

PrintServers and NetworkPeripherals

Built-in Printservers for

**EPSON**

**KYOCERA**

HEWLETT PACKARD BROTHER



INTERCON-BOX INTERCON-POCKET

'Plug and Play' InterCon-PrintServers  
with Multiprotocol support of

- NOVELL (IPX), UNIX (TCP/IP)
- Apple Ether/TokenTalk
- MS LanManager / Advanced Server / IBM LanServer
- WindowsNT, Windows for Workgroups, Windows '95

#### Hardware Support

- Ethernet 10Base2 (BNC), 10Base5 (AUI), 10BaseT (RJ-45)
- Token Ring STP (IBM Type 1/2), UTP (IBM Type 3)

#### Features

- Automatic recognition of the used network connector
- Software-Update/Upgrade via Download in Flash-EPROM
- Status report of the printer directly from Host computer
- Automatic protocol recognition
- Configuration parameters can be edited by software
- Automatic recognition and reaction to network changes
- Support of 64 queues on 16 servers under Novell
- Easy installation with Novell's PCONSOLE

#### For more information contact:

SEH Computertechnik GmbH  
Sunderweg 4 D-33649 Bielefeld  
Phone: +49 / 521 / 942260  
Fax: +49 / 521 / 444049  
Compuserve Id: 100016,3703  
Internet: rcl@sehgmh.bi.eunet.de



**SEH**  
Computertechnik GmbH



OEM?  
Call for our  
white paper



# SMARTPAD™

Simplify Access to All Applications and Their Features.

Buttons can launch programs, run recorded macros, send menu/keystroke commands and execute DDE commands

Launch Microsoft Word 6.0

Convert any application into a Windows shell

Use any bitmap as button face or combine text and bitmaps

Helpful popup ButtonClues™

Use innovative tab buttons to create multiple button "layers"

Embed or attach custom toolpads on any program window

Create floating pad palettes that pop up automatically or on-demand.

Add a macro recorder, task manager and run... processor to any toolpad

## Embed Customizable Toolbars in Any Application!

- Standardize the look, feel and function across applications from different vendors.
- Create customized shell to replace Program Manager.
- Add BalloonHelp and ButtonClues to any application for ease of use.
- Automate repetitive and complex tasks with macros, DDE, scripts, etc.
- Automate data sharing across Windows, DOS and host-based applications.

Circle 320 on Inquiry Card.



**Special Offer!**

STANDARD EDITION	\$89
PROFESSIONAL EDITION	\$199

**30-Day Money Back Guarantee**

### REVIEWS

*"The toolbar utility to end all toolbar utilities"*

- PC WORLD

*"Almost revolutionary"*

- WINDOWS SOURCES

*"Among the most impressive inter-application automation tools for Windows"*

- COMPUTER SHOPPER

*"Stands head and shoulders above anything else of its type in my experience"*

- WINDOWS ON-LINE



**Softblox**

1201 WEST PEACHTREE STREET / ATLANTA, GEORGIA 30309  
FAX. 404.892.0981

**Call us today! 800-434-0202**

\* For more info call our FAXBACK LINE 404-892-1309



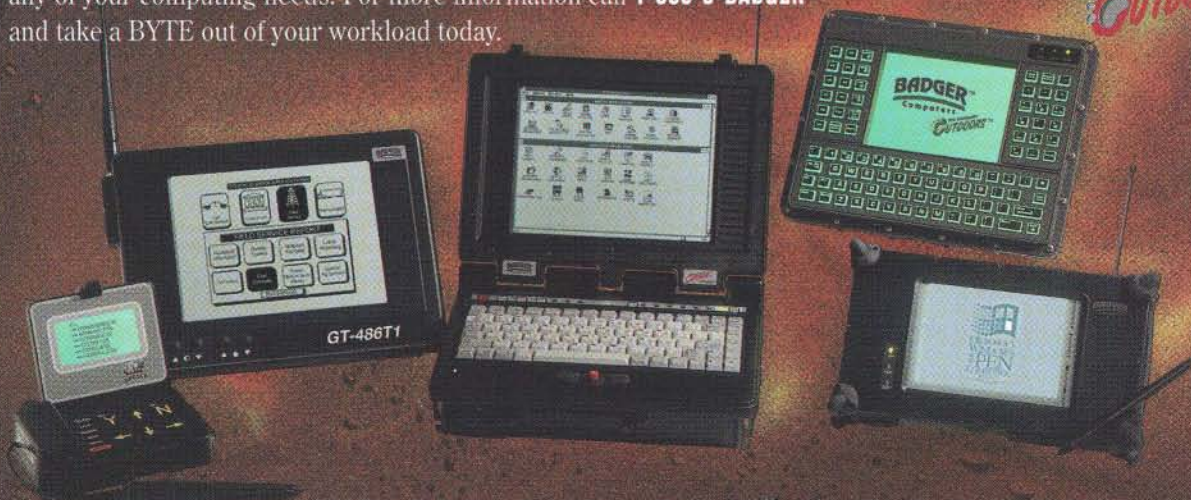
# Outdoor Stamp of Approval

**Ferocious Computing Devices** If your working conditions bring out the rigors of the environment, you need the only line of computers with the outdoor stamp of approval. Badger is the most extensive line of rugged mobile computers available anywhere in the world. Badger offers custom configurations with numerous wireless connectivity options including ARDIS, RAM, Cellular/CDPD, Spread Spectrum, CDPD, and Private Network. Barcode scanners and integrated GPS are also available. Products are DOS/Windows-compatible and designed for mobile data collection, distributed processing, and communications to support any of your computing needs. For more information call **1-800-3-BADGER** and take a BYTE out of your workload today.



**BADGER**<sup>TM</sup>  
Computers

The Computer  
**OUTDOORS**<sup>TM</sup>

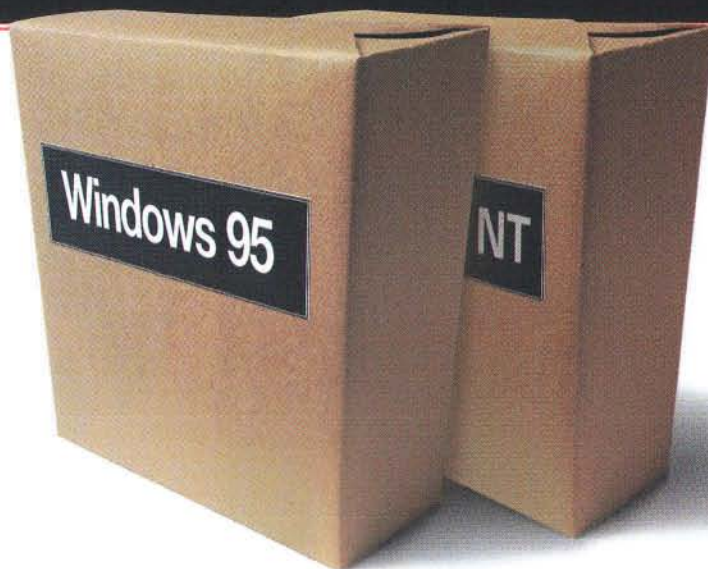


BADGER Computers • 10901 Malcolm McKinley Drive • Tampa, Florida 33612 • (813) 972-6246 • FAX (813) 972-6715

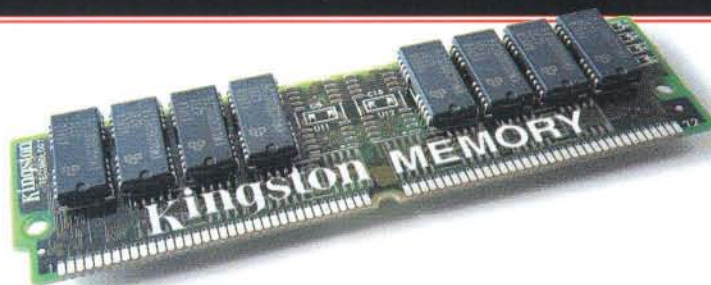
A Division of Group Technologies Corporation  
Circle 312 on Inquiry Card.



# Thinking Windows?



# Think memory. Think Kingston.



Windows® NT. Windows 95. OS/2. All the hype about these powerful, new operating systems overlooks one tiny fact—most PCs and servers simply can't run them unless you add more memory. But Kingston can help you meet the demands of today's memory-hungry software, no matter what kind of systems you have.

You see, Kingston makes memory modules for more than 2,300 kinds of PCs, workstations, and printers. Not just all of the newest models from the leading brands, we make memory for all of the

older systems too. Plus, we're the only ones who actually test 100% of our memory. And all of it comes with a lifetime guarantee.

How can you find the right memory configuration for your particular systems? That's easy. We make an electronic guide that helps find the exact memory you need in seconds. It's called the KEPLER configuration guide and it comes on a convenient, new Windows CD. You can get it free by calling (800) 251-9058. Or download it from our BBS by calling (714) 435-2636 or from CompuServe by typing GO KINGSTON.



**Kingston**  
TECHNOLOGY CORPORATION

For information on our memory products, call (800) 251-9058.

Kingston Technology Corporation, 17600 Newhope Street, Fountain Valley, CA 92708 USA, (714) 435-2600, Fax (714) 435-2699.

© 1995 Kingston Technology Corporation. Kingston Technology is a registered trademark of Kingston Technology Corporation. All rights reserved. Windows is a registered trademark of Microsoft in the U.S. and other countries. All other products or services are the trademarks or registered trademarks of their respective holders.

**Circle 225 on Inquiry Card (RESELLERS: 226).**



# Collision!

**Despite cultural differences and compatibility problems, integration of computers and telephony is fast becoming reality**



**T**he wait is over. After years of broken promises and incompatible "standards," CTI (computer telephony integration) is ready. Hundreds of vendors have introduced products—from headsets, to vertical-market telephony applications, to development and design tools, to turn-key phone systems—that will enable your telephones, computers, and networks to work together.

Tying together today's two most important connectivity technologies isn't a new idea. CTI's promise has been discussed for years. But radically different technologies, competing interests, and incompatible standards have, until recently, put the connection process on hold. Now all that is changing.

Look at the histories and business practices of the telephone and computer industries, and you might wonder how they could ever find common ground. For a variety of technical, economic, and legal reasons, the two industries have walked vastly different paths. But the potential has become too great to ignore. Savvy computer users now realize that harnessing the link between phone and computer can increase users' efficiency and improve customer relations—two code terms for making money.

In "Standard Issue," James Burton discusses the basic technical issues of CTI. Architectural and standards issues are far from settled, and the company that wants to use CTI has to make important decisions concerning a bewildering variety of APIs, standards, protocols, and hardware configurations. Burton sorts through this mass of conflicting information and three-letter acronyms, identifying the major issues and players.

In "Building Telephony Applications," Burton looks at the

types of applications that CTI makes possible. Since CTI is still in its early stages, it's probable that you'll have to develop your own custom CTI application. Burton discusses what you should look for in evaluating and choosing a development toolkit.

Finally, in "Telephony's Killer App," John P. Mello Jr. looks at several of the most interesting new telephony applications to be found. ■

—Russell Kay, Technical Editor

## Standard Issue

CTI design models, architectures, industry standards, APIs, and other issues that affect hardware/software integration and interoperability issues .....**201**



## Building Telephony Applications

What you need to consider when picking a development toolkit for creating an integrated voice-processing application .....**211**



## Telephony's Killer App

A look at commercial applications with the potential to revolutionize the way you do business and organize your operations .....**215**







## It Makes People Look Professional. It Makes People Look Smart. It Makes People Look.

It's a Proxima Desktop Projector.<sup>™</sup> It connects to your computer and projects large-screen images. Anything from simple graphics to full-motion multimedia presentations. And yes, you need one. Because with it, you can communicate more effectively and more efficiently than ever before.

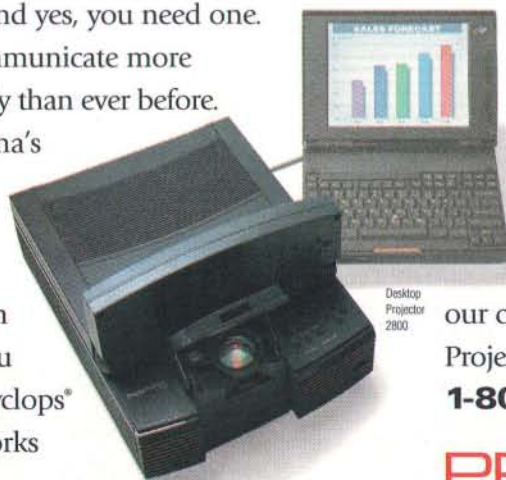
But that's not all. Proxima's Desktop Projector is easy to use—just plug it in like a monitor. It's easy to carry around—it even fits under an airplane seat. And it puts you in command. Our unique Cyclops<sup>®</sup> interactive pointer system works

like a cordless mouse to give you total control of your software from anywhere in the room. Any software, any presentation, any platform.

Suddenly, your presentations are more impressive. Your points more memorable. Your workgroups more productive.

All because you have a Proxima Desktop Projector.

To receive information on our complete line of Proxima Desktop Projection<sup>™</sup> products, call us today at **1-800-447-7692, Ext. 652.**



# PROXIMA<sup>®</sup>

THE DESKTOP PROJECTION COMPANY

Main Office: 9440 Carroll Park Drive, San Diego, CA 92121-2298, (619) 457-5500, FAX (619) 457-9647, (800) 447-7694 (U.S.A. and Canada). European Office: Horderweg 24, 6191 RX Beek, The Netherlands, +31-43-650 248, FAX +31-43-649 220. Proxima and Cyclops are registered trademarks of Proxima Corporation. Desktop Projector and Desktop Projection are trademarks of Proxima Corporation. Other trademarks are the property of their respective owners. U.S. and foreign patents are pending. Copyright 1994 Proxima Corporation. All rights reserved. Specifications are subject to change without notice.

**Circle 99 on Inquiry Card (RESELLERS: 100).**



# STANDARD ISSUE

Integrating your computers and phones? Here's a guide through the maze of design approaches, technologies, standards, APIs, and industry politics.

JAMES BURTON



Things used to be so simple. There was only one type of light bulb. Gasoline was all leaded. Mustard was only yellow. Now incandescent lights are being replaced with fluorescents and halogens, gasoline has at least three octane ratings, and mustard fills three shelves at the supermarket.

It's the same with telephones and computers. When they didn't need to talk to each other much, a modem was more than sufficient. But now, the business advantages of computer-based call control are forcing this unnatural bond. Springing up to cement the union are myriad APIs and hardware designs. Without an understanding of how they work and which are most likely to succeed, you could wind up with a CTI (computer telephony integration) system destined for the scrap heap.

## CTI Architectures

Today's CTI systems generally fall into one of four different architectures or configurations, based on their approach to making the actual connections and managing calls. (See the figure "Four CTI Architectures" on page 202.)

*Phone-centric systems* are the easiest to implement; they only require a direct link from the phone to an external adapter that connects to the PC's serial or parallel port. They don't require extensive changes to an existing phone system. Users can have direct control over call routing (known as *first-party call control*). To transfer a call, for example, the user just clicks on an icon, and the PC sends a message to the switch that emulates a command from the phone requesting the switch to transfer the call.

Many PBX vendors offer adapters that give that kind of control to the PC. Unfortunately, these adapters don't provide a connection to the phone line and can't be used to connect data or fax lines to the PC.

*Server-centric systems* connect your telephone switch to a server on your LAN. Here, the phone system becomes another

VICTOR GADSBY © 1995



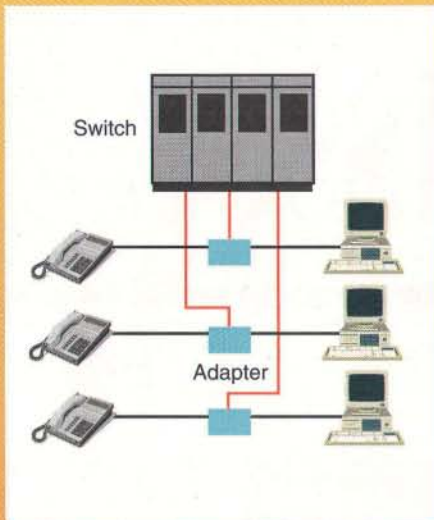
## FOUR CTI ARCHITECTURES

### Phone-Centric

The phone is linked via an external adapter that connects to the PC's serial or parallel port (and soon via a USB [universal serial bus]). The PC is not directly connected to the phone line, but rather to the adapter.

**ADVANTAGES:** Such systems are easy to implement and don't necessitate extensive changes to an existing telephone system.

**DISADVANTAGES:** Today's adapters don't provide a connection to the phone line and cannot be used to connect data or fax lines to the PC. This will change with USB.

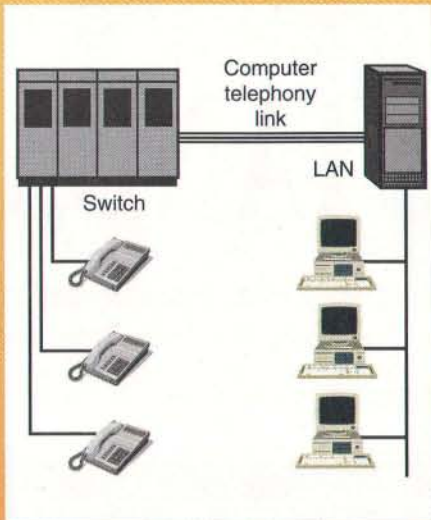


### Server-Centric

Here the phone lines connect to a switch, which in turn connects to a telephony server on the LAN. The LAN server manages call routing, although it has to have the switch perform the actual transfers.

**ADVANTAGES:** No physical connection is needed between the phone and the desktop PC. Third-party call control is good for workgroups and call centers.

**DISADVANTAGE:** The server can't perform automated, intelligent switching of different types of calls—fax, voice, and data.

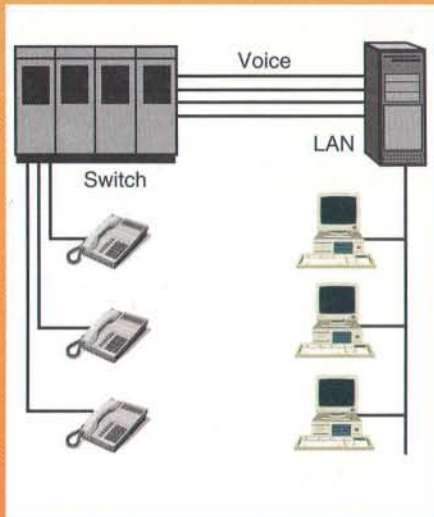


### Voice-Server

Phone lines are connected to a board in a voice server that sits on the LAN. The server gets the voice or data call, but not control information—just the opposite of what happens in the server-centric configuration.

**ADVANTAGES:** This configuration provides access to the media stream (e.g., voice, data, and fax).

**DISADVANTAGES:** A phone line can only control a call that it has received or placed; it can't send other types of instructions to the switch. This architecture can be too slow for call-center operations.

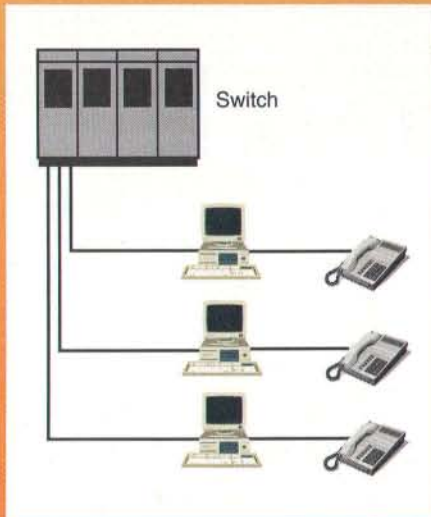


### PC-Centric

The telephone line and the phone itself are connected directly to an add-in board in the PC. The telephony board emulates the phone to the switch.

**ADVANTAGES:** This configuration provides a direct voice path from the phone into the PC, which is useful for I/O operations. Ultimately, it can eliminate the PBX entirely.

**DISADVANTAGES:** This is an expensive solution, because considerable processing power is required in each PC. If the system uses proprietary phones, it's even more costly.



part of the computer network, and you don't need a physical connection between the phone and individual desktop PCs. The LAN server, not the switch or the user, is responsible for routing calls (thus, it's termed *third-party call control*).

To transfer a call, the user clicks on the transfer icon, which sends a message to the server requesting that it transfer the call. The third party (the server) sends a message telling the switch where to route the call. The server's processing power lets it screen and route incoming calls. For example, caller-ID information may help route the call to the proper person. Third-party call control is particularly helpful in workgroups and call centers.

But the server-centric model manages only call control. The switch-to-server link is for status and requests only. It doesn't carry the voice path and in no way physically connects a phone line to the server. For a server to send and receive faxes and

data, a physical phone line would have to be connected to a fax-modem board in the server.

*Voice-server systems* are a variation on the server-centric model. Where server-centric systems deliver call-control links but not the calls themselves, voice-server systems deliver the calls directly, but not a separate control-and-status link.

In a voice-server model, phone lines from the switch connect to a board in the voice server. Depending on the board's capabilities, the lines can be analog, ISDN, or proprietary digital. The board can do anything that the phone it replaces can do; for example, it can issue a flash hook to transfer, conference, hold, call park, call forward, initiate call pickup from another office, and so forth. Digital phones usually have other features, such as speaker-phone control and caller-ID display.

With the phone line going into a voice server, you get the media—that is, the

voice path, or the data path for faxes and modem calls—but you don't get all the information and control that's available on the server-centric model. For example, a phone line can't force the switch to take control of another call; it can only control a call that it has received or placed. It can't tell the switch to forward a call from the next office to another phone.

In a server-centric call-center application, the server receives the caller ID and tells the switch where to send the call. In the voice-server model, on the other hand, the call is sent to the server, which must then answer it and transfer the call. But this is just too slow for a call center.

*PC-centric systems* have the telephone line and the telephone itself connected directly to an add-in board in the PC. The telephony board emulates the type of telephone that the switch is designed to support, whether analog or proprietary digital.

When we have isochronous Ethernet or



## Strategic Industry Alliances

### Versit

An important alliance is Versit, formed by Apple, AT&T, IBM, and Siemens in 1994. It aims to define a comprehensive solution, enabling the development of configuration-independent CTI applications that work in direct-connect or client/server configurations.

Versit will support PDAs (personal digital assistants), personal computers, pay phones, proprietary digital phones, and servers. The planned *Versit CTI Encyclopedia* will define terminology, configurations, feature sets, call flows, protocols, the Versit TSAPI (Telephony Server API) procedural API, and object classes.

In June, Versit released its first specifications on the World Wide Web ([www.versit.com](http://www.versit.com)).

### ECTF

In April, Dialogic, Digital Equipment, Ericsson Business Networks, Hewlett-Packard, and Northern Telecom formed the ECTF (Enterprise Computer Telephony Forum) to promote an open, competitive market for CTI. ECTF is the first consortium of end users, vendors, systems integrators, and software developers to work toward implementing CTI based on international standards.

ECTF will promote implementations for CTI elements and will also deal with both call control and media-stream-processing issues. The forum will not select or promote specific CTI technologies (as Versit has), but it will work toward interoperability among standards and technologies.

### ECMA/CSTA

The ECMA (European Computer Manufacturers Association) has formulated a standard, called CSTA (Computer-Supported Telephony Applications), to enable computers and telephone systems to communicate.

But CSTA is not an API—it's a communications protocol specifying how to make the connection between a phone switch and a computer. "The problem," according to Dialogic's Carl Strathmeyer, "is that while switch vendors all claim to support the CSTA standard feature set, they all implement them differently." For example, the transfer command might mean one function for one vendor's CTI product but trigger a different response from another vendor's system.

ATM (asynchronous transfer mode) data pipes going directly into our PCs, which looks to be the long-term prospect, we'll use PC-centric telephony systems. For the shorter term, however, we'll see fax-modem boards with telephony features that will provide an interim solution.

### TAPI Dancing

Beyond network configuration, there are issues of APIs to iron out before you can point and click your way through the phone network. Two leading APIs (Microsoft/Intel's TAPI and AT&T/Novell's TSAPI), plus an emerging technology (Tmap from Nortel, formerly Northern Telecom), are designed to bring them together.

The most widely known current standard is TAPI (Telephony API). Developed by Intel and Microsoft to support both client and server telephony, TAPI's key attributes are its tight integration with Windows, support for coexisting multiple applications, telephone network independence, support for all the different CTI configurations, and access to the information carried over the telephone line. Of course, it can also dial, forward, transfer, and perform other signaling operations. TAPI supports a wide variety of telephone networks, including PSTN (the Public Switched Telephone Network), PBXes, ISDN, cellular, and Centrex.

Besides supplying support for first- and third-party call control, TAPI provides a

software interface for accessing media streams (i.e., the information carried end-to-end over the telephone network). This means TAPI can support applications such as answering machines, voice mail, conferencing, faxes, voice recognition, and data. TAPI also supports a wide range of telephone-switching equipment, such as legacy PBXes, voice servers, and PC-based switches, as well as a variety of network connections, including isochronous LANs and ATM networks.

To date, TAPI has been implemented on Windows 3.1 and Windows 95. Microsoft has announced the TAPI implementation for Windows NT, which will allow suitably equipped NT machines to be computer-telephony clients (for the end user) or telephony servers on a network. TAPI allows desktop PCs to be either physically connected clients of a switch system or logically connected software clients of a Windows NT server.

So, if the phone and PC are physically connected at the desktop with, say, a Comdial TAPI adapter, TAPI interfaces between the Windows application and the Comdial hardware. In a server environment, TAPI interfaces with the server application running in the NT server.

This is where Microsoft and TAPI have a big edge over TSAPI—tight integration into the desktop PC's OS, combined with tight integration into the server OS. This is a big win for developers because they can

easily port their software from first-party to third-party applications.

"Since TAPI is a standard part of the Windows family, developers and customers don't have to pay extra or try to figure out how to install a bunch of plumbing to enable their applications," says Charles Fitzgerald, a product manager in Microsoft's Personal Systems Division.

### TSAPI, Anyone?

TAPI's main competitor, TSAPI (Telephony Server API), was developed by AT&T and Novell. TSAPI is an API for call control, call/device monitoring and query, call routing, and device/system maintenance for workgroups on a NetWare network. It integrates NetWare services with the functionality of a telephone PBX.

TSAPI uses the link between the PBX and the NetWare file server to create a logical connection at the workstation between the individual phone set and the desktop computer. This link enables an application to deliver the full capabilities of the phone system, control calls from either end of the call, or give a third party complete call-control and monitoring abilities.

Using TSAPI, many software developers are delivering client/server applications that provide desktop dialing, visual voice mail, integrated messaging (i.e., fax, voice mail, and E-mail), conference-call bridging, sales-call restriction, and data/call synchronization. For example, the NetWare Telephony Services product from Novell is designed to provide easy server-based administration of a CTI environment. It also enables applications to generate usage reports, as well as access and share central network databases.

However, TSAPI has a problem: It does not provide media access—that is, it does not provide a physical connection between the PC and the phone. Consider this scenario: A fax call comes in. Because TAPI accesses the call directly, it's smart enough to recognize a fax tone and can automatically transfer the call to a designated fax application on the user's PC.

A TSAPI-based server, however, would have no direct way of knowing what kind of call it is. It might, perhaps, recognize the calling phone number as a fax line that it already knows about. But even then, it can't transfer the call directly; it has to instruct the switch to do so.

TSAPI's designers evidently assumed that only call control really mattered. Now they're playing catch-up. Versit, an industry consortium (see the text box "Strate-



# Unleash your Pentium/Alpha!

Microway's NDP Fortran & C/C++ are the only 32-bit compilers which take full advantage of the Pentium and Alpha's dual numerics units. They run on DOS, UNIX, OS/2, NT and OS/F. To get RISC numeric performance from a Pentium or Alpha you need to schedule your code and use Superscalar optimizations. In his Jan. '95 Dr. Dobbs article, S. Fried describes how to get 35 megaflops from a Pentium using NDP Fortran. The Alpha version of NDP Fortran hits 88 megaflops running on OS/F or NT systems or on DOS using Microway's new ISA add in card. Put our compilers on Pentium, i860 and Alpha systems to work for you today. Call for white papers on Pentium, i860, or Alpha Code Generation, OS/2 or our Pentium FDIV fix, now!

## i860/Pentium/Alpha SuperComputers

**BX Series Pentium/Alpha/i860 Workstations** - Microway's workstations and industrial PC's come configured with DOS, OS/2, UNIX, From....\$2195

**Gigacube**® Three to six QuadPuters - Up to 24 i860's for \$50K! Computational Server runs NFS.

**NumberSmasher**®-860 Up to 80 megaflops, does 1024 FFT in just .9 ms, From.....\$2995

**QuadPuter**®-860 Four 40 MHz i860's plus shared memory equals 320 megaflops .....\$11995

**ArrayPRO/XP**™ - 100/200 megaflops, 400 MB/Sec memory, 80 and 33 MB/Sec DSP Interfaces.... \$8995

**NumberSmasher**®-Alpha 100+ megaflops - this ISA Superscalar add in card runs on DOS or UNIX. It uses T8 links for parallel processing. From \$5995

## NDP Compilers

Microway's family of 32-bit compilers run on DOS, OS/2, NT, UNIX, and OS/F generating code for the Intel 386, 486, Pentium, i860 and DEC Alpha.

**NDP Fortran**™ is a full F77 with complete VMS, F66, DOD, and MS extensions.

**NDP C/C++**™ runs in K&R, ANSI and C++ modes and generates the highest quality numeric code of any 32-bit C compiler.

**NDP Pascal**™ is a full ISO Level 0 translator.

DOS releases include VCPI, DPMI, NDPLink, VM, NDPLib and GREX-Microway's bit mapped graphics library. The 486/Pentium version adds 486/Pentium code generation, Clearview, the MGX vector graphics library, and DPMI DOS Box support for demand paging and GREX.

386 Version 4.41.....\$695  
Pentium/486 Version 4.5.....\$995

OS/2 releases use IBM Tools, take advantage of the IBM WorkFrame and include MGX

386.....\$595  
486/Pentium.....\$895

Alpha NDP compilers start at.....\$795

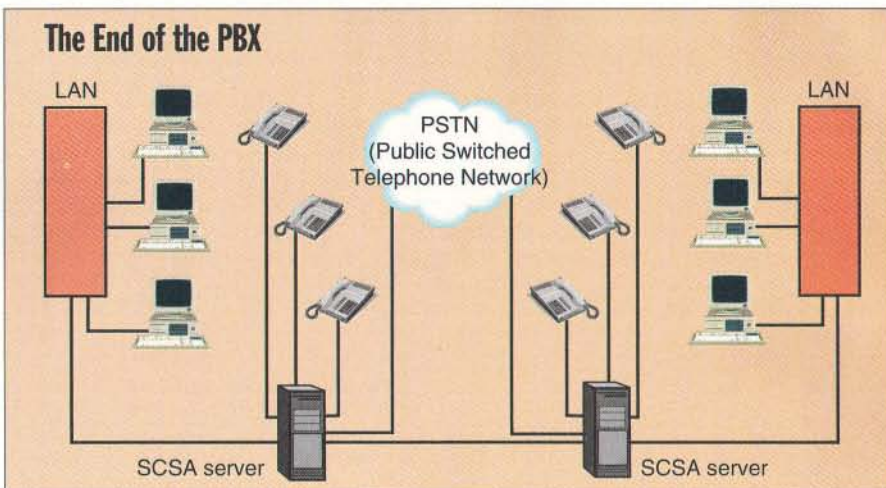
Call for UNIX, OS/F and NT pricing.

NDP Fortran 90 extensions to NDP Fortran...\$295

# Microway®

Research Park, Kingston, MA 02364 USA  
(508) 746-7341 FAX (508) 746-4678  
Call for Germany, India, Indonesia, Israel,  
Japan, Poland, Russia and U.K.

## STATE OF THE ART Standard Issue



We'll say farewell to the PBX as we know it when SCSA (Signal Computing System Architecture) servers on our networks are linked to each other and to the telephone company's central office.

gic Industry Alliances" on page 203), has adopted TSAPI as a cornerstone of its CTI solution and says it will develop extensions to handle media-control services.

A wide range of PBX companies and ISVs (independent software vendors) support TSAPI. Many PBX manufacturers in the U.S., Europe, and Japan—including Alcatel, AT&T, Comdial, Ericsson, Fujitsu, Mitel, NEC, Nortel, and Siemens/ROLM—have committed to developing NetWare drivers for their PBXes.

TSAPI supplies support for multiple desktop OSes, including OS/2, Windows, UnixWare, and the Mac OS. In addition, Versit has announced that it will extend TSAPI support to include Windows NT.

### Tmap Ties APIs

With the CTI world choosing sides, users need a bridge to unite the two main telephony APIs. Tmap provides that link between TAPI and TSAPI, and it has been adopted by the ECTF (Enterprise Computer Telephony Forum). Tmap was developed by Nortel, which worked closely with Intel and received support from both Microsoft and Novell.

Tmap enables TAPI-based applications to work with PBX systems designed to support TSAPI. By translating TAPI programming calls to TSAPI requests, Tmap also lets TAPI-compatible desktop applications run on networks using NetWare Telephony Services. Developers can now build applications for the universal Windows client, which enables users to use whatever back-end server they choose.

Susan King, director of CTI at Nortel, explains that the company "created Tmap with the intention of easing developer con-

fusion and has made it available to the industry free of charge."

Extending Tmap to the ECTF umbrella was a natural extension, and the ECTF will be able to define Tmap's evolution based on input from multiple vendors, which should ensure its viability in the marketplace. King notes that Nortel "has agreed to evolve Tmap based on the ECTF specifications and future iterations of TSAPI and TAPI."

### Bringing in Resources

The real bottleneck in cross-platform interoperability is not the API but the lack of a resource model for the API to call. Every switch vendor implements a different model for each telephony command. Two different models are vying to become an architectural standard.

SCSA (Signal Computing System Architecture) is an industry initiative started by Dialogic and now supported by more than 260 companies. SCSA is a comprehensive hardware and software architecture for building call-processing systems with multiple technologies and standard interfaces. The architecture covers many facets of system design, from low-level bus and hardware interfaces to high-level software APIs.

With SCSA, developers can integrate multivendor components within standard PCs or larger computer systems using the VME bus, which enables them to create computer-telephony systems ranging from medium to very large in size. The hardware-independent SCSA software model is compatible with TAPI and TSAPI.

The SCSA TAO (Telephony Application Object) Framework is the software



# STATISTICA

Windows 3.1  
and Windows 95

**STATISTICA™** (automatically configures itself for Windows 3.1 or WINDOWS 95) ■ A complete data analysis system with thousands of on-screen customizable, presentation-quality graphs fully integrated with all procedures ■ Comprehensive *Windows*® support, OLE (client and server), DDE, customizable *Auto Task* toolbars, pop-up menus ■ Multiple data-, results-, and graph-windows with *data-graph* links ■ The largest selection of statistics and graphs in a single system; comprehensive implementations of: Exploratory techniques with advanced brushing; multi-way tables with banners (presentation-quality reports); nonparametrics; distribution fitting; multiple regression; general nonlinear estimation; stepwise logit/probit; general ANCOVA/MANCOVA; stepwise discriminant analysis; log-linear analysis; confirmatory/exploratory factor analysis; cluster analysis; multidimensional scaling; canonical correlation; item analysis/reliability; survival analysis; a large selection of time series modeling/forecasting techniques; structural equation modeling with *Monte Carlo* simulations; and much more ■ On-line *Electronic Manual* with comprehensive introductions to each procedure and examples ■ Hypertext-based Stats Advisor expert system ■ Workbooks with multiple *AutoOpen* documents (e.g., graphs, reports) ■ Extensive data management facilities (fast spreadsheet of unlimited capacity with long formulas, *Drag-and-Drop*, *AutoFill*, *AutoRecalculate*, split-screen/variable-speed scrolling, advanced Clipboard support, DDE links, hot links to graphs, relational merge, data verification/cleaning) ■ Powerful *STATISTICA BASIC* language (professional development environment) with matrix operations, full graphics support, and interface to external programs (*DLLs*) ■ Batch command language and editable macros, flexible "turn-key" and automation options, custom-designed procedures can be added to floating *Auto Task* toolbars ■ All output displayed in *Scrollsheets*™ (dynamic, customizable, presentation-quality tables with instant 2D, 3D, and multiple graphs) or word processor-style report editor (of unlimited capacity) that combines text and graphs ■ Extremely large analysis designs (e.g., correlation matrices up to 32,000x32,000, unlimited ANOVA designs) ■ Megafile Manager with up to 32,000 variables (8 Mb) per record ■ Unlimited size of files; extended ("quadruple") precision; unmatched speed ■ Exchanges data and graphs with other applications via DDE, OLE, or an extensive selection of file import/export facilities (incl. *ODBC* access to virtually all data bases and mainframe files) ■ Hundreds of types of graphs, incl. categorized multiple 2D and 3D graphs, ternary 2D/3D graphs, matrix plots, icons, and unique multivariate (e.g., 4D) graphs ■ Facilities to custom-design new graph types and add them permanently to menus or toolbars ■ On-screen graph customization with advanced drawing tools (e.g., scrolling and editing of complex objects in 32x real zoom mode), compound (nested) OLE documents, *Multiple-Graph AutoLayout Wizard*, templates, special effects, icons, page layout control for slides and printouts; unmatched speed of graph redraw ■ Interactive rotation, perspective and cross-sections of 3D displays ■ Large selection of tools for graphical exploration of data: extensive brushing tools with animation, fitting, smoothing, overlaying, spectral planes, projections, layered compressions, marked subsets ■ Price \$995.

**Quick STATISTICA** (for Windows) ■ A subset of *STATISTICA*; comprehensive selection of basic statistics and the full analytic and presentation-quality graphics capabilities of *STATISTICA* ■ Price \$495.

**STATISTICA/QC - Industrial statistics add-on package** (requires *STATISTICA* or *Quick STATISTICA* for Windows) ■ The largest selection of industrial statistics in a single package; quality control charts (compatible with real-time data acquisition systems), process capability analysis, R&R, sampling plans, and an extremely comprehensive selection of experimental design (DOE) methods ■ Flexible tools to customize and automate all analyses and reports (incl. "turn-key" system options, and tools to add custom procedures) ■ Price \$495.

**STATISTICA/Mac** (for Macintosh) ■ Price \$695 (Quick - \$395).

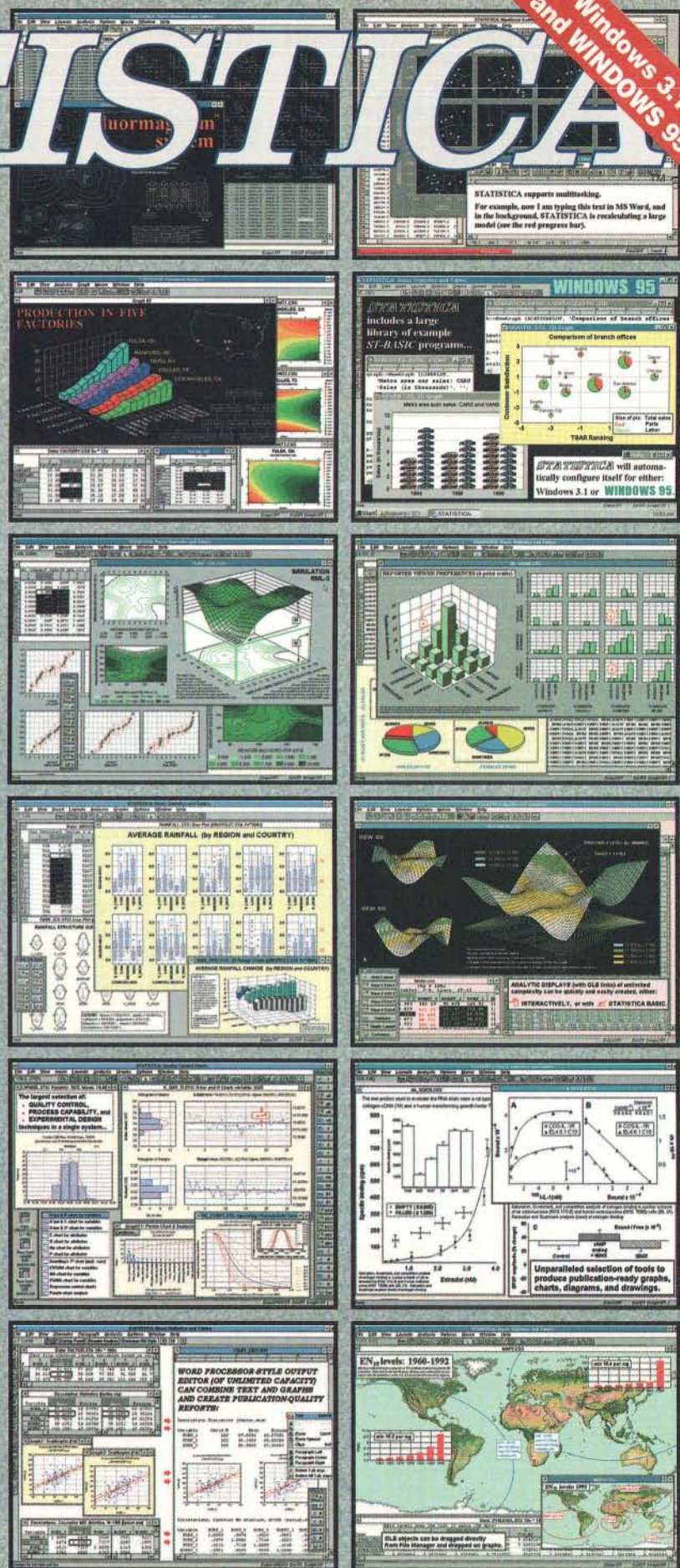
Domestic sh/h \$12 per product; 30-day money back guarantee.



**StatSoft®**

2325 E. 13th St. • Tulsa, OK 74104 • (918) 583-4149  
Fax: (918) 583-4376

**Overseas Offices:** StatSoft of Europe (Hamburg, FRG), ph: 040/ 4200347, fax: 040/4911310; StatSoft UK (London), ph: 01462/482822, fax: 01462/482855; StatSoft Pacific (Melbourne, Australia), ph: (03) 663 6580, fax: (03) 663 6117; StatSoft France ph: (1) 45 66 97 00, fax: (1) 45 66 06 51; Available from other Authorized Representatives worldwide:  
Sweden: AkademiData Scientific ph: 018-210035, fax: 018-210039; Finland: Statcon Oy ph: 24-334678, fax: 24-333867; Belgium: Texma NewTech ph: 010 61 16 28, fax: 010 61 69 57; South Africa: Osiris ph: 12-663-4500, fax: 12-663-6114; Japan (Macintosh): Three's Company, Inc., ph: 03-3770-7600, fax: 03-3770-7784; Japan (Windows): Design Technologies, Inc., ph: 03-3667-1110, fax: 03-3668-3110; Italy: Prompt SRL ph: 49-893-3227, fax: 49-893-2897; Poland: Companion Oprogramowanie ph: 12-369680, fax: 12-360791; Taiwan: Intelligent Integration Corp. ph: 2-759-1791, fax: 2-759-1790. StatSoft, the StatSoft logo, STATISTICA, and Scrollsheet are trademarks of StatSoft, Inc.



Circle 89 on Inquiry Card.



portion of SCSA. This object-oriented architecture provides an open infrastructure that lets independent applications share a pool of discrete telephony resources—generally, call channels and data-stream-processing resources.

This is particularly important because one of the big issues (and common requirements) of telephony is real-time transmission. Computer-telephony resources require more complex resource management than does simple data transmission, which can often tolerate minor delays. This is comparable to a conversation stopping in midword and your having to wait for an indeterminate amount of time for another packet of wisdom to finish the word.

Client applications to a TAO server running in a client or desktop PC typically call the server through an SPI (service provider interface), which converts one type of service to another. (Tmap, which converts TAPI to TSAPI, is a good example.) Usually the SPI is in the client software, but it can be in the telephony server.

An SCSA server can have many different operations and calls going on, and it has to be able to support them all in real time to avoid annoying delays; this is known as *dynamic resource sharing*. For example, say two calls come into an SCSA server at once. One caller uses an interactive voice-response system to retrieve data from a database linked to the server, while the second caller requests a fax back.

The SCSA server needs to handle both calls simultaneously. And it has to be able to hand off the fax call for data-stream processing when the second caller sends the appropriate command (and has turned on his or her fax machine).

The model makes it simple for an application to pass call-data streams between different processing resources (e.g., recorders, recognizers, and phone ports) and also between applications. This allows, for example, an E-mail message to become a database query or another transaction.

## A Checklist for Making CTI Decisions

**W**ith the maze of technologies, products, and standards to choose from, what are you to do when faced with designing a system or picking components? Consider the following issues when choosing a CTI (computer telephony integration) platform:

- **Flexibility of the network.** Is it compatible with TCP/IP, IPX/SPX, and NetBEUI?
- **Applications.** Is the

environment robust enough for multimedia and telephony applications development?

- **Multitasking.** Does the environment allow for multiple and simultaneous functions to avoid putting calls on hold?

- **Reliability.** Is the environment stable enough to ensure that a mission-critical application, such as call control, won't crash?

- **Open design.** Is the API compatible with a wide

range of PBX systems?

- **Media stream.** Will the environment handle multiple media devices, including fax, data, voice, and video equipment?

- **Pricing.** Is the API bundled with a comprehensive operating environment?

- **Scalability.** Does the environment support a range of form factors, platforms, and multimedia applications, as well as high-volume user traffic?

SCbus (a part of the SCSA initiative) also allows servers to work together more easily. If you have multiple SCSA servers, for example, one server may need resources from another. In this situation, the time slots of the two servers aren't contiguous, so a *hyperchannel* is used to give one server access to a time slot in another server. SCbus supports this bundling of time slots, which is especially useful for transmitting services such as video.

"SCSA solves the fundamental problem in CTI today—developing a common resource model," comments Carl Strathmeyer, director of marketing at Dialogic and chairman of the CTI trade association ACTAS (Alliance of Computer-Based Telephony Application Suppliers). "Until now, developers would have to modify their software to work with each switch vendor's resource specifications. With SCSA and the ECTF, it's very encouraging to see industry vendors finally agreeing to a single open architecture that software and telephone-equipment vendors can build around in total confidence."

### Green with MVIP

An older alternative to the SCSA hardware platform is MVIP (Multivendor Integration Protocol), which is another digital auxiliary bus. The SCSA TAO software environment supports both.

MVIP is based on the Mitel ST bus reference design and was defined in 1990. It's a bus developed for use in computer-telephony servers as well as to allow videoconferencing workstations to hop from an ISDN or T1 adapter card to an H.320 videoconferencing codec.

MVIP uses a distributed switching model that's similar to modern PBX architectures and makes software development easy, and bandwidth and CPU utilization

highly efficient. (However, SCbus offers even more bandwidth than MVIP.) It's used in telephony servers and for distributed computer-telephony systems.

### If It's Plug-and-Play, Whose Plug?

Besides a software API and architectural platform, CTI needs a standard mechanism for connecting peripheral devices. The RJ-11 phone jack can't carry the load, and the RS-232 serial port is too cumbersome. To address these limitations, two new contenders have emerged: USB (universal serial bus) and GeoPort. Both will be used in phone-centric designs, because the phone line connects to an adapter or to a phone with a built-in interface.

USB was jointly developed by Compaq, Digital Equipment, IBM, Intel, Microsoft, NEC, and Nortel. It has a multi-drop interface and uses a single connector for phones, modems, keyboards, mice, game ports, serial devices, digital audio, printers, and scanners. It has a built-in port for connecting to PBXes, ISDN lines, Centrex systems, and even POTS (the industry acronym for "plain old telephone service"). With the vendor support that it has, USB will become a standard feature on most PCs by mid-1996.

The USB specification will simplify and improve the performance of PC-to-peripheral and PC-to-telephony applications. It will bring support for new computer-telephony integration capabilities—communicating mixed-media information, including sound, images, and data—and will eliminate the need for special add-in telephony connections.

USB runs at 12 Mbps, compared to the standard PC serial port's speed of 115 Kbps. It also offers isochronous and asynchronous data transfer, a star-hub architecture that allows a single PC-port con-

<b>Comdial</b>	(800) 466-7835
Charlottesville, VA	(214) 684-3726
(804) 978-2200	
<b>ECTF</b> (Enterprise Computer Telephony Forum)	<b>SCSA</b> (Signal Computing System Architecture)
Foster City, CA	c/o Dialogic Corp.
(415) 578-6852	Parsippany, NJ
fax: (415) 378-6692	(201) 993-3000
<b>Nortel</b> (formerly Northern Telecom)	<b>Versit</b>
Richardson, TX	c/o Apple Computer
	Cupertino, CA
	(408) 862-5154



ONE SIMPLE WAY  
TO BE ANYWHERE THEY ARE.



**Digi**

**INTRODUCING LANASERVER.  
THE COMPLETE, HIGH-SPEED, REMOTE  
ACCESS SERVER.**

TELECOMMUTERS AND MOBILE WORKERS ARE SPREAD FAR AND WIDE, AND THEY'RE MULTIPLYING EVERY DAY. THEY WANT FAST FRUSTRATION-FREE ACCESS TO NETWORK RESOURCES, AND YOU NEED A SOLUTION THAT CAN KEEP UP WITH DEMAND. NOW THERE'S DIGI INTERNATIONAL'S LANASERVER, A HIGH-PERFORMANCE, MULTI-PROTOCOL, REMOTE ACCESS SOLUTION. THIS TURNKEY REMOTE ACCESS SERVER IS NOT ONLY THE FASTEST OF ITS KIND, IT'S ALSO READY FOR ANYTHING THE FUTURE THROWS AT YOU. WITH A 230 Kbps DATA RATE, IT'S ALREADY TWICE AS CAPABLE AS ANY MODEM. OUR RS-232 AND PCMCIA MODELS MAKE UPGRADING EASY AS FASTER MODEM SPEEDS BECOME AVAILABLE. AND THEY SUPPORT BOTH V.34 MODEMS AND ISDN. LANASERVER IS JUST ONE PRODUCT IN THE BROAD LINE OF DIGI REMOTE ACCESS SOLUTIONS, SO WHEREVER USERS ARE, YOU'LL BE WITH THEM. TODAY AND TOMORROW. FOR MORE INFORMATION, CALL 1-800-551-4797.

U.S.A. (612) 943-9020 • EUROPEAN OFFICE TEL

+49 221 920 52 0 • DIGI INTERNATIONAL ASIA PTE LTD

TEL +65 732 1318 • INTERNET: [HTTP://WWW.DIGIBD.COM](http://WWW.DIGIBD.COM)



©1995 DIGI INTERNATIONAL. ALL RIGHTS RESERVED. ALL

BRAND NAMES AND PRODUCT NAMES ARE TRADEMARKS

OR REGISTERED TRADEMARKS OF THEIR RESPECTIVE HOLDERS.

**Circle 65 on Inquiry Card (RESELLERS: 66).**





# AnthroCarts!®

AnthroCarts will knock your socks off! Imagine how great it'll be when you find the perfect furniture for your equipment — just the right size, tough as nails construction and dozens of accessories.

And you'll find our service so real and responsive, you'll get a kick out of ordering direct!

Call for a free catalog!



Lifetime Warranty.



Adjustable for all sizes.



Lots of choices.

**800-325-3841**

6:00 AM to 6:00 PM PST, M-F

e-mail: [sales@anthro.com](mailto:sales@anthro.com)



10450 SW Manhasset Drive  
Tualatin Oregon 97062  
Phone: (503) 691-2556  
Fax: (800) 325-0045

GSA contract no. GS-OOF-5040A. Available for OEM applications. Prices from \$159.00  
Anthro, AnthroCart and Technology Furniture are registered trademarks of Anthro.

## STATE OF THE ART

troller to link up to 63 digital peripherals, and automatic recognition and configuration of external USB-based peripherals.

GeoPort, the other contender, is Apple's point-to-point interface. It supports phone/PC connection, as well as devices such as Apple's digital camera. In a CTI architecture, GeoPort provides the connection between the PC and the phone, as well as a flexible means of attaching peripherals via a single, compact, mini-DIN connector.

GeoPort is a cross-platform interface that delivers voice, data, audio, and video communications over any analog (POTS) or digital (PBX or ISDN) telephone line to a PC. It provides a flexible, scalable architecture for multiplexing several dozen simultaneous data streams, such as the 24 channels found in an ISDN primary-rate interface.

Versit opted for Apple's GeoPort architecture, which allows isochronous communications as fast as 2 Mbps. The Versit GeoPort provides up to 200 times the bandwidth of traditional serial ports.

### Bye-Bye, PBX

We believe the recipe for a successful CTI system will likely include the following:

- Architecture: SCSA
- API: TAPI (for some NetWare users, the Versit version of TSAPI)
- PC operating environment: Windows NT for mission-critical CTI applications
- Physical interface: USB

The future of CTI will consist of departmental and workgroup solutions where SCSA-based servers operate behind existing switch systems. The trend toward increasing intelligence in call control will result in a platform-independent API that will enable cost-effective applications development. The next step will put the switching technology into the PC server.

Emerging CTI applications are transport-independent—they don't rely on the underlying switch architecture. Once we arrive at the stage where the phone is just another part of the PC, transport-independent CTI applications are running over isochronous Ethernet or ATM, and SCSA servers are connected directly to the PSTN, we can finally say good-bye, once and for all, to proprietary PBXes. ■

*James Burton is the CEO of C-T Link, Inc., in Boston, Massachusetts. You can reach him on the Internet at [jbarton@internetmci.com](mailto:jbarton@internetmci.com) or on BIX c/o "editors."*



# Something Missing?

**Complete your BYTE collection by ordering Back Issues today!**

	1990	1991	1992	1993	1994	1995
January						
February						
March						
April						
May						
June						
July						
August						
September						
October						
November						
December						
Special Issues	IBM					

**Rates (postage and handling included): Only credit cards or Eurochecks accepted!**

Holland **Dfl 20.00**  
 United Kingdom **& 7.75**  
 West Germany **DM 18.00**

Switzerland **SwFr 16.00**  
 France **FFr 59.00**  
 Sweden **SEK 80.00**

**Please indicate which issues you would like by checking (✓) the boxes. Send requests with payment to: BYTE Back Issues, c/o Dynamic Graphics International, P.O. Box 25, 3950 AA Maarn, The Netherlands**

☐ Check enclosed

**Charge:** ☐ MasterCard ☐ Eurocard ☐ American Express ☐ VISA

Card # \_\_\_\_\_

Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

Postcode \_\_\_\_\_ City \_\_\_\_\_

Country \_\_\_\_\_

**BYTE**

Because the *Experts* decide.

**All orders must be prepaid. Credit cards preferred.** Please allow three weeks for delivery by surface mail.



# It's for you.™

Now build telephony applications as easily as picking up the phone.

## Visual Voice

The #1 telephony toolkit is also the easiest to use. And the most powerful. Guaranteed.

Stylus and Dialogic simplify telephony development with an open and graphical approach to standards-based voice and fax processing.

Extend any application with phone or fax support!

- Touch-Tone Order Entry
- Employee Benefits Hotline
- Fax-On-Demand
- Outdialing Patient Reminder
- Integrated E-mail/Voice Mail
- Client/Server Call Center

Build telephony applications using standard Windows development tools!

- OLE Control and VBX versions for Visual Basic, Visual C++, PowerBuilder, and more.
- Windows™ 95, Windows NT, and Windows 3.x.
- TAPI, voice recognition, text-to-speech, caller ID, and all advanced telephony features.

Includes ready-to-run voice mail, auto-attendant and fax-on-demand samples. Develop and test with any sound card. Royalty-free distribution and 30-day money back guarantee!

Call right now and receive a **FREE** computer telephony mini-dictionary. Pick up the phone. Because Stylus and Dialogic have the telephony solution for you.



(32)2 725 08 90

Stylus Innovation, Inc. • Cambridge, MA • USA

FAX: 617-621-7862 • e-mail: sales@stylus.com • WWW: <http://www.stylus.com>

Dialogic • Belgicastraat 4, Keibergpark 3 • 1930 Zaventem, Belgium • FAX: (32)2 725 42 75

Circle 355 on Inquiry Card (RESELLERS: 356).



# BUILDING TELEPHONY APPLICATIONS

Dozens of development tools, many based on Visual Basic, can help you create a voice-processing system

JAMES BURTON

**P**ress 1 to speak with a sales representative. Press 2 to reach technical support. Press 3 to listen to some lovely Muzak....” We’ve all had firsthand experience with infuriating voice-menu systems that drone on and on with options we don’t want to hear. But that’s not a fair summary of what computer telephony is all about. Modern, well-designed telephony applications can do much for an organization—and for those who call it.

What is a telephony application? At its simplest, it’s the automation of the handling of telephone calls: answering the phone, greeting the caller, and responding to a request—all without a human operator. As it grows more complex, it incorporates many other functions, including digit capture, storing and forwarding of voice messages, database access, automatic speech recognition, text-to-speech conversion, storing and forwarding of fax data, fax response, dialing out, and tracking usage statistics.

So far, the most successful voice-processing applications automate existing manual functions. These usually show a rapid, measurable payback. This is probably a transitional stage, however. It reflects the relative newness of CTI (computer telephony integration). As more organizations create a wider variety of applications, we will begin to better understand how CTI can serve us. In a few years, we’ll be using applications that we haven’t even thought of now. As more organizations use telephony, those that don’t may be at a competitive disadvantage.

## It’s Not Just New Software

While most of us think of applications primarily in terms of software, it’s important to factor in hardware when you’re dealing with telephony. The profusion of telephony standards (see the article “Standard Issue” on page 201) means that you must know what hardware you’re going to run



VICTOR GAO © 1995



your telephony application on before you create it—and even before you pick a development tool or environment.

In addition to the hardware you'll run your application on, consider the external hardware and software you'll connect to. Look at the interface to the telephone system and the external database. What kind of PBX do you have? What kind of phone lines link you to your local telephone company's central office? What other services are available? You may have analog or digital line options. Switching and information services, such as DID (direct inward dialing) and caller ID (widely but not universally available), are important to know about at the beginning.

In addition to selecting the appropriate services, you need to make sure that the voice-processing boards and the applications generator support those services. Also, it's important to know how many telephone ports you'll need. You can determine this by estimating the telephone traffic during the busiest hour of the day and deciding on the quality of service you need. Then you can consult telephony traffic tables to find out just how many ports you'll need. If you're connecting to the telephone network through a PBX, the same basic considerations are required, although you may find yourself constrained by the services and capacities your PBX will support.

One last external factor you need to consider is any existing databases—customers or orders, for example—you will use with the telephony application. You'll want to

## Sitting Pretty

The Henredon Furniture Company (Morganton, NC) had seven customer-service representatives, each struggling to handle 150 dealer inquiries a day about stock availability. The volume of calls meant that many callers were getting busy signals. Others were put on hold for extended periods. West Coast dealers were especially upset be-

cause customer service ran on East Coast hours, which made late-afternoon and weekend inquiries virtually impossible.

To help spread the load, Henredon used Ease from Expert Systems (Atlanta, GA) to implement an interactive voice-response inquiry system. This enabled dealers to find out about such things as case goods, fabrics, upholstery frames,

product availability, order status, and other sales data.

The voice-response system handles 480 calls per day and generates 11,000 transactions. The high availability of the system is another major benefit. Since installing the system, Henredon has added fax-response capability so that dealers receive a hard copy of order status and inventory information.

pick a development tool that integrates easily with your database and gives reliable access to the information you need.

### Telephone-Taming Toolkits

OK, you've opted to go the computer telephony route, and you've got an idea of the hardware and other software you'll connect to, so what's next? A variety of development tools is available, ranging from simple programming libraries through telephony utilities to comprehensive applications generators.

These tools assist in building telephony applications for a variety of operating environments and with a variety of programming methodologies. The table "Applications Generators for Telephony" on page 213 gives summary information about many toolkits. Some have the ability

to implement or integrate with voice mail, fax processing, speech recognition, text-to-speech converters, telephony switching (e.g., conferencing and call forwarding), and data communications capabilities. As with any software project, good tools can cut the development time and cost substantially. They often enable organizations to build their own applications rather than seeking outside help (see the text box "How Much Will It Cost?" on page 214).

### Picking the Right Tool

All these tools aren't designed to do the same job. The right voice-processing applications generator is the one that best matches your experience and skills and the needs of a specific application. Most vendors are offering or planning multiple products that support multiple methods. Among the factors you should consider are the programming skills of your developers, what platforms you want to use, what telephony features you plan to use in your application, and the quality of support provided by the vendor.

*Menu-driven or script-based?* If some or all of the development will be done by people with little programming experience, it makes sense to pick a menu-driven product. With these, you construct your application by connecting specific functions—for example, answer phone, play prompt, or get digits—which are commonly referred to as actions. Governing each action is a set of parameters that is presented to the user in a menu, typically giving defaults and other choices. Menu-based applications generators require a minimum learning investment, and they are useful when you need to create an application rapidly.

If the application is complex, however,

## Calling Dr. Blue

Brigham and Women's Hospital (Boston, MA) has made a major commitment to computer telephony. Using the Visual Voice applications generator from Stylus Innovation (Cambridge, MA), it has implemented five voice-processing applications. According to technology planner Pashe Roberts, the hospital environment, with its small departments, creates the need for many small-scale voice-processing applications.

The five applications at Brigham and Women's cover a variety of functions and areas. One lets nurses call in and report a specific environmental problem and its location. With another one, expectant mothers can register for childbirth classes. A third application aids the hospital's telecommunications technicians. They can


























test the quality of a phone line by calling into the system and recording a message; the system calls them back, and they can listen to their message. The fourth application lets a centralized monitor provide audible information, via telephone, about the operational status of the client/server network. With the latest application, HMO subscribers can verify referral numbers.

One big reason the hospital selected Visual Voice was that Visual Basic was already used extensively within the hospital. The hospital had developed a special Visual Basic driver to tap into one of its primary database systems, one written in MUMPS.

The hospital plans to add new telephony applications. Among the projects it will undertake are desktop telephony using TAPI (telephony API), plus text-to-speech and speech-recognition systems.



### APPLICATIONS GENERATORS FOR TELEPHONY

VENDOR	PRODUCT NAME	PLATFORM	PROGRAMMING INTERFACE	PRICE OF DEVELOPERS KIT—MINIMUM/FULL CONFIGURATION	PRICE OF RUN-TIME FOR 4 / 8 / 16 / 24 / 48 TELEPHONE PORTS	INQUIRY NUMBER
Apex Voice Communications, Sherman Oaks, CA, (800) 727-3970 or (818) 379-8400	<b>OmniVox</b>	Unix		\$2400 / \$5600	\$1400 / \$2800 / \$5600 / \$8400 / \$16,800	1238
Big Sky Technologies, San Diego, CA, (800)736-2751 or (619) 496-2100; fax (619) 565-2114	<b>Remark</b>	OS/2		\$6364 / \$6364	\$23,164 / \$45,564 / \$90,364 / \$135,164 / —	1239
Cascade Technologies, Inc., New York, NY, (212) 768-7380	<b>CAS Voice</b>	OS/2		\$2300 / \$19,320	\$1150 / \$2070 / \$2760 / — / —	1240
CTI Information Services, Reston, VA, (703) 648-1610; fax (703) 648-1678	<b>Apprentice</b>	Unix		\$6500	Varies	1241
Cypress Research, Sunnyvale, CA, (408) 752-2700; fax (408) 752-2735	<b>PhonePro</b>	AppleTalk	 	\$349 / \$849	\$199–\$548 per port	1242
Edify, Santa Clara, CA, (800) 944-0056 or (408) 982-2000	<b>Electronic WorkForce</b>	OS/2	 	\$11,400 / \$13,100	\$7800 / \$15,600 / \$31,200 / \$46,000 / \$86,520	1243
Expert Systems, Atlanta, GA, (404) 642-7575	<b>Ease 3.0</b>	MS-DOS	 	\$695 / \$16,295	\$495 / \$945 / \$1245 / \$1445 / \$2045	1244
IBM, Research Triangle Park, NC, (800) 426-4211	<b>CallPath DirectTalk/2</b>	OS/2		\$4000 / \$11,800	\$4000 / \$8000 / \$16,000 / \$24,000 / \$48,000	1245
Info Systems, Toronto, Ontario, Canada, (800)825-5434 or (416) 665-7638; fax (716) 855-2244	<b>Talkie</b>	MS-DOS	 	\$715	\$100 per port	1246
Intelligent Computer Technology, Norcross, GA, (800) 441-9077 or (404) 441-9077; fax (404) 441-2727	<b>PhoneLink</b>	Windows		\$729 (includes card) / \$1745	\$2695 (hardware add-ons above 4)	1247
ITI Logiciel, Montreal, Quebec, Canada, (514) 597-1692; fax (514) 526-2362	<b>Multi-Voice</b>	MS-DOS		\$149 / \$599	None	1248
International Voice Systems, Hamden, CT, (203) 288-4461; fax (203) 288-4552	<b>Insight</b>	OS/2		\$3740 / \$7084	\$1870 / \$2618 / \$3368 / \$3740 / \$4488	1249
KDS Corp., Wilmette, IL, (708) 251-2621; fax (708) 251-6489	<b>Vox</b>	MS-DOS, OS/2		\$15,000 (includes five run times)	0 / \$600 / \$1350 / \$2450 / \$6650	1250
MasterMind Technologies, Vienna, VA, (703) 848-9040	<b>MasterVox</b>	OS/2		\$1995 / \$3185	\$400 / \$800 / \$1600 / \$2400 / —	1251
MediaSoft Telecom, Montreal, Quebec, Canada, (800) 558-3839 or (514) 731-3838; fax (514) 731-3833	<b>IVS Builder/Server</b>	Unix	 	\$950	\$1980 / \$3680 / \$5060 / \$9200 / \$17,520	1252
Parity Software Development, San Francisco, CA, (415) 989-0330; fax (415) 989-0441	<b>Vos</b>	MS-DOS		\$1885 / \$20,350	\$660 / \$1320 / \$2640 / \$3960 / \$7920	1253
PCVoice, Roswell, GA, (800) 443-8201 or (404) 343-8201; fax (404) 442-3156	<b>Assist Pro/FP</b>	Windows		\$325 / \$449	None	1254
Pronexus, Carp, Ontario, Canada, (613) 839-0033; fax (613) 839-0035	<b>VBVoice</b>	Windows/Visual Basic		\$395	\$995 / \$1295 / \$1695 / (32) \$1995	1255
SpeechSoft, Ringoes, NJ, (609) 466-1100 fax (609) 466-0757	<b>Speech Master</b>	MS-DOS		\$595 / \$3144	\$895 / \$1145 / \$1395 / \$1395 / —	1256
Stylus Innovation, Cambridge, MA, (617) 621-9545; fax (617) 621-7862	<b>Visual Voice</b>	Windows/Visual Basic		\$495 / \$2785	None	1257
Talking Technology, Alameda, CA, (510) 522-3800; fax (510) 522-5556	<b>Peak Toolkit</b>	MS-DOS, Windows		\$399	None	1258
Technically Speaking, Southborough, MA, (508) 229-7777; fax (508) 229-8777	<b>Show N Tel</b>	OS/2	  	\$995 / \$7000	\$700 / \$1400 / \$2800 / \$5160 / \$12,240	1259
Telephone Response Technologies, Roseville, CA, (916) 784-7777	<b>ProVide</b>	MS-DOS, Windows 3.1/Visual Basic	 	\$723 / \$12,352	\$1145 / \$2145 / \$3455 / \$4069 / \$5845	1260
U.S. Telecom International, Joplin, MO, (800) 835-7788 or (417) 781-7000; fax (417) 623-2963	<b>Val</b>	MS-DOS		\$1995 / \$1995	\$600 / \$1200 / \$2300 / \$3300 / \$5700	1261
Voice Information Systems, Santa Monica, CA, (800) 234-8474 or (310) 392-8780	<b>VFedit</b>	MS-DOS	—	\$395	None	1262
Voicetek Corp., Chelmsford, MA, (508) 250-9393	<b>Generations</b>	VAX/VMS, SunOS	 	\$18,000	\$800 / \$1600 / \$3200 / \$4800 / \$9600	1263
Voysys, Fremont, CA, (800) 786-9797	<b>VoysAccess</b>	Windows 3.1		\$595 / \$595	\$495 / \$990 / \$1485 / \$1980 / —	1264
Winters Development, Manti, UT, (801) 835-0100; fax (801) 835-0103	<b>VoiceKit</b>	MS-DOS		\$599	\$599 / (12) \$799 / (24) \$999 / \$2599	1265



## STATE OF THE ART Building Telephony Applications

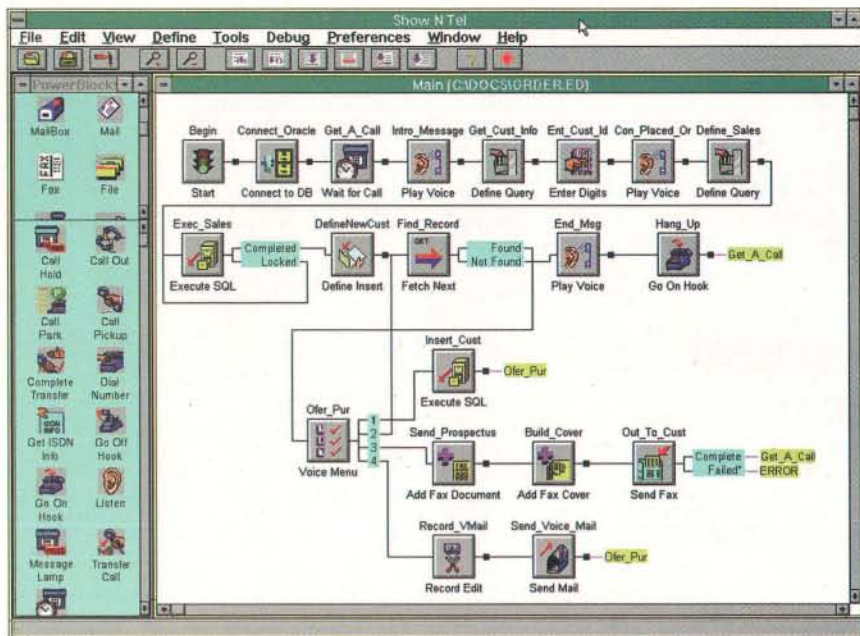
a menu-driven applications generator may not have all the functions you need. Although many of them are comprehensive, they're limited to those features the vendor has decided to include. Connectivity is frequently the most limiting factor.

Consider, too, whether you want a tool that uses a graphical interface or a character-based interface. GUI-based applications generators appeal to the point-and-click oriented. As with many other visual programming tools, you build an application by connecting action icons together.

For organizations with in-house programming expertise, products using a scripting language will typically provide more flexibility to the developer than menu-based products. The price you'll pay is an increase in development and support times. Also, some vendors' menu-based and scripting-language products are compatible with each other, but others aren't. If this is important, check it out.

Consider whether you want your programmers to learn a new language, or whether you want to use one of the many popular voice-processing tools based on Visual Basic, such as Stylus Innovation's Visual Voice or Pronexus's VBVoice. Many applications generators also let you include your own C functions.

**Processing platform.** Most voice-processing development systems create applications for one operating environment. You should choose your platform and tool carefully. Windows 3.1 is an inferior multitasking OS, for example. For telephony systems that have many ports, or for critical-performance applications, DOS-based applications generators typically produce



This application was developed using the graphically oriented toolkit Show N Tell from Technically Speaking. It is an order-verification system that includes interactive voice response, fax on demand, and database querying.

the best results. These systems don't actually use DOS as the run-time OS; instead, they rely on their own embedded OS, which is designed specifically for voice-processing applications and is extremely efficient.

The vendors that have been around the longest are Expert Systems, SpeechSoft, Telephone Response Technologies, and U.S. Telecom. Although all their products have improved, they're still essentially identical to what they were offering 10 years ago. For example, they still use DOS. Although there's significant pressure to migrate to other OSes, the reality is that DOS-based systems provide performance

### TAX MAN

Jackson Hewitt Tax Service (Virginia Beach, VA) issues loans secured by anticipated tax refunds. This year, the company generated \$14 billion worth of refund checks, which generated many calls from banks to verify that it had issued the checks. Most of these calls came during a two-week period.

The company created an interactive voice-response system using the Provide applications generator from Telephone Response Technologies (Roseville, CA). The programmer, Lee Perkins, learned the package and set up the entire application in less than two weeks. He used the forms-based package rather than the scripting language, believing that the ease-of-use and support benefits of the forms-based product would outweigh the time needed to learn it. According to Perkins, TRT's documentation made the package easy to learn and use.

### How Much Will It Cost?

The price tag on an applications development tool is only one part—and maybe a small part—of the final cost of your telephony application. Two other important considerations are run-time fees and how many telephone ports your system will use. To determine your true costs, you'll want to figure out your expenses on a per-port basis.

The price leaders are Stylus Innovation (with no run-time fees) and SpeechSoft, while Apex Voice Communications, Cascade Technologies, Expert Systems, MasterMind Technologies, Parity Software, Technically Speaking, Telephone Response Technologies, and U.S. Telecom are higher. The differences are smaller than they ap-

pear, however, because virtually all the vendors also sell voice-processing boards, and most bundle a board in their basic systems. If you need only a few ports, for example, you can get a starter kit from TRT, SpeechSoft, or U.S. Telecom for less than \$1000. All kits include a Dialogic board.

Another difference is how options are priced. Most vendors have a laundry list of options, all priced extra. A few bundle everything in the basic product.

Voice-processing products from Edify, Big Sky, and Voicetek are at another level. These are expensive systems from total-solution suppliers. Consider them if you need a package that includes applications development, training, and ongoing support.

and capability that are comparable, or superior, to systems based on Windows 3.1, Unix, or OS/2, and they're less costly. ■

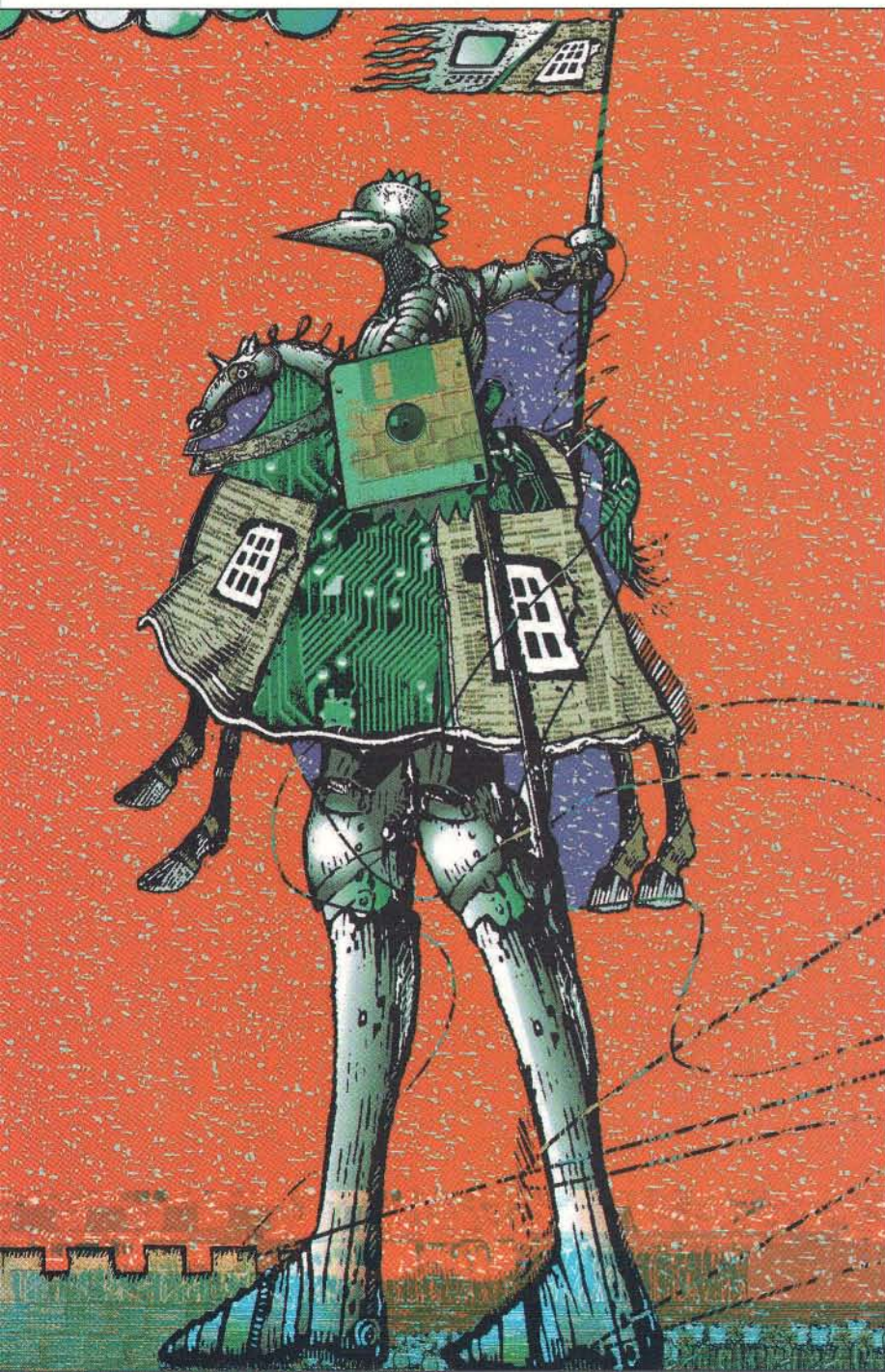
James Burton is CEO of C-T Link, Inc., a computer telephony consultancy based in Boston, Massachusetts. You can reach him on the Internet at [jbarton@internetmci.com](mailto:jbarton@internetmci.com) or on BIX c/o "editors."



# TELEPHONY'S KILLER APP

It'll take an irresistible new application to make computer-telephony integration happen everywhere. Will one of these apps do it?

JOHN P. MELLO JR.



**W**e'll never look at telephones the same way again. New and innovative systems are tying the easy voice connections of the phone system to the data transfer and manipulation power of computer networks. The combination is extraordinarily seductive.

Over the next five years, we'll see our phones and computers transformed from separate boxes into a seamless entity that will integrate data and voice. Before this can happen, users have to want the change. What's likely to sell them on the idea is an application that captures the imagination and provides immediate productivity rewards—in other words, a killer app.

"The killer app revolves around new ways of doing telephony through intelligent computing," explains Ron Charnock, vice chairman of the Multimedia Telecommunications Association (Washington, D.C.). "It's thinking of telephony as a computing resource and less of a telecommunications resource."

A phone call will become a digital entity that can interact with other digital entities on our desktops and networks. It will carry contact information about its originator and trigger the assembly of data from computer files. It will become data itself and give our organizations crucial information about their operations.

## No More Baffling Buttons

Current phone systems are a pain for most users, whose skill with advanced telephony features drops off drastically when they need to use more than the 12 buttons on the standard phone keypad. For those folks, the killer app will turn those incomprehensible extra phone buttons and multi-key operations into friendly screen icons. "Businesses are spending anywhere from \$100 to \$1000 for these fancy business phone sets, and people don't use them," says David Goodtree, a senior analyst with Forrester Research (Cambridge, MA).

*continued*



"The killer app will replace those sets with \$30 software that people will use."

Killer apps will integrate many diverse forms of messaging. Electronic mail will convert to voice mail, and voice mail to text. The system will read received faxes over the phone, and pager messages will become voice mail. "The killer app is any type of application that unifies your current business solutions with the telephony environment," notes Michael Durant, a senior product manager with Novell.

Does telephony's killer app exist now, or is it waiting to be invented? A number of new, powerful, and intriguing applications are already out there, and it's too early for the marketplace to render a verdict. Let's look at some of the contenders.

## Phone, Take Notes

The killer network app may very well be PhoneNotes, telephony groupware from Lotus Development that sits on top of Notes. PhoneNotes supports applications that enable users to tap into a Notes database through a Touch-Tone phone. One such application, Mobile Mail, lets a user access, create, forward, or edit Notes documents and play documents over the phone through text-to-speech technology.

"One of the attractive features of Notes is the increase in productivity it gives you through greater mobility," explains Peter Klante, Lotus's director of marketing for Notes companion products. "This is a logical extension to that. It turns the most ubiquitous client in the world—the telephone—into a Notes client."

## Data for Dialing

Some observers believe the guts of a killer app lie in the exchange of simple data. Versit, a joint development initiative by Apple, IBM, AT&T, and Siemens to develop CTI standards (see "Strategic Industry Alliances" on page 203), has laid the groundwork. One of those standards establishes a protocol for the exchange of electronic business cards. "This is really, really important and potentially a killer app," says Jerry Michalski, managing editor for the newsletter *Release 1.0*. "If every time people touch electronically, they can swap their latest contact information, they can suddenly communicate much more efficiently."

It will also eliminate what Michalski calls mode-switching friction—what you encounter when you try to mix media such as voice mail and E-mail with contacts outside your organization. Once these elec-

## Wildfire: One Wild and Not-So-Crazy Helper

One measure of a white-collar worker's status is often a personal secretary or executive assistant. A killer app may replace human helpers with an intelligent agent that would be totally digital. Wildfire Communications has incorporated this idea into a product called Wildfire, a HAL-like presence eavesdropping on every call you make.

What makes Wildfire such an exciting and powerful application, however, is that you don't need a computer to use it. You can link up with Wildfire from any phone, even a cellular or pay phone, or have it call you wherever you are. No matter where you are, you have full access to its capabilities.

You can tell Wildfire to sort your messages and play them back to you, or you can ask it to play a message from a sender by speaking his or her name. You can respond to a message immediately by simply saying the messenger's name or number. Wildfire will dial it for you, or send a message to the caller's pager. If you're on one call and receive another, Wildfire "whispers" the caller's name in your ear and lets you decide whether or not to interrupt your current call or relay a specific message to the new caller. It will schedule and remind you of

follow-up calls, and it will forward calls to different numbers (cellular, hotel, home, etc.) based on your schedule. And Wildfire will let you prioritize contacts so it can screen your calls during hectic times.

During a Wildfire session, you call up the agent by simply saying "Wildfire" and pausing. Suddenly, a female voice announces "Here I am!"—the signal that Wildfire is waiting for your instructions. "It acts like a person you'd want to work with, as opposed to acting like a machine," says William J. Warner, CEO and founder of Wildfire Communications. "There are a lot of telephony applications that are Touch-Tone-based that act like machines. That's not what people want. They want to be able to talk to their assistant and get stuff done."

The software uses several speech-recognition technologies that add up to a natural, conversational feel for the user. For example, here's a typical Wildfire dialog for setting up a contact:

**User:** Wildfire.

**Wildfire:** Here I am.

**User:** Create a contact.

**Wildfire:** What kind?

**User:** Person.

**Wildfire:** What's the name?

**User:** John Mello.

**Wildfire:** Once more.

**User:** John Mello.

**Wildfire:** Which phone number should I add?

**User:** Work.

**Wildfire:** What's the number?

**User:** 555-1212.

**Wildfire:** Got it.

Wildfire uses discrete speech recognition to understand responses to its questions, such as what kind of contact and which phone number, because these responses are single words. When the user gives the new contact's name, however, the system uses trained speech because it needs to learn a new pattern. The system uses a speaker-independent continuous recognizer for numbers.

As impressive as Wildfire is, however, some industry insiders think it lacks one crucial component that a true CTI killer app needs: a seamless connection to what's happening inside the computer on the knowledge-worker's desk. Wildfire handles phone functions with elegance, but it doesn't connect to the data that's the lifeblood of an organization's operations, or to applications the worker may have running.

Wildfire runs on a dedicated server, a 90-MHz Pentium box with 128 MB of memory and 16 digital signal processors from Texas Instruments. Prices start at \$50,000.

tronic calling cards become widespread, they can be a bridge between the desktop and the handset. When you check your voice mail, the calling card information is sent to your PC, and a screen pop displays the information. To return the call, just click on the phone number. You'd rather send E-mail? Click on the person's E-mail address. Fax? Web home page? Just click away. Mode-switching friction is reduced to zero. "The calling card protocol is so low-end and so simple you can do anything with it," Michalski contends.

## It's Voice—No, It's Data

For this electronic calling-card idea to fly, it has to become easier to send data over

ordinary phone lines. One promising development is a modem-based technology called VoiceView from Radish Communications Systems. VoiceView lets a user switch between voice and data transmission on an analog phone line, without losing his connection, as long as there's a VoiceView-enabled modem at both ends of the line.

Exchanging voice and data on one line isn't a new idea. Two years ago, MultiTech (Mounds View, MN) introduced a hardware/software product that allowed users to send voice and data simultaneously. But the MultiTech product was pricey, and the parallel approach caused some degradation of the voice portion of



# GEAR TEST

ELEKTROSON



THE POWER OF EXCELLENCE  
IN CD-R SOFTWARE

## WHO KNOWS BETTER HOW TO OFFER QUALITY IN CD-ROM SOFTWARE THAN GEAR !

**GEAR. CD-R SOFTWARE YOU CAN TRUST !**

### CROSS PLATFORM FLEXIBILITY

Whether you're a Windows, Windows 95, Windows NT, MacOS, OS/2, or UNIX user, GEAR ensures unmatched cross platform support for every CD-ROM format including 660, Rock Ridge, and HFS. GEAR will continue to be the first to support future drives and standards including incremental writing.

### MULTIMEDIA POWER

GEAR is also available in multimedia versions supporting XA, DA, Hybrid, Shared Hybrid, CD-I, VideoCD, Game titles, and Custom Image Writing. If you want a CD-R software solution with the most **power, flexibility and reliability**, buy GEAR today ... CD-R software you can trust !

### FORMATTING SPEED

GEAR provides the **fastest virtual formatting speeds** and includes support up to ISO Level 3.



**PLEASE SEND ME  
"THE GEAR TEST CD" !**

Try Gear and convince yourself of the power, reliability and quality of this CD-R software. Send or fax this card to :

- Elektroson Europe  
PO Box 2436, 5600 CK Eindhoven. Fax : +31(0)40-514920
- Elektroson U.S.A.  
10 Presidential Boulevard, suite 125, Bala Cynwyd, PA 19004  
Fax : 610-617-0856

NAME : .....  
COMPANY : .....  
FUNCTION : .....  
ADDRESS : .....  
STATE : .....  
TELEPHONE : .....  
FAX : .....  
OPERATING SYSTEM : .....



## STATE OF THE ART Telephony's Killer App

the call, so it didn't win wide acceptance. In contrast, VoiceView is inexpensive, doesn't degrade voice, and is being bundled with a number of modems.

Companies that have hopped on the Radish vegetable cart include Boca Re-

search (Boca Raton, FL), U.S. Robotics (Skokie, IL), Hayes Microcomputer Products (Atlanta, GA), Diamond Technologies (Anaheim, CA), and Zoom Telephonics (Boston, MA). In addition, Microsoft includes driver support for

VoiceView in Windows 95. Considering its support in Windows and the number of modem makers adopting Aurora's technology, industry pundits expect VoiceView to make a big splash in the market. Some analysts project that as many as 10 million modems will incorporate VoiceView by 1998.

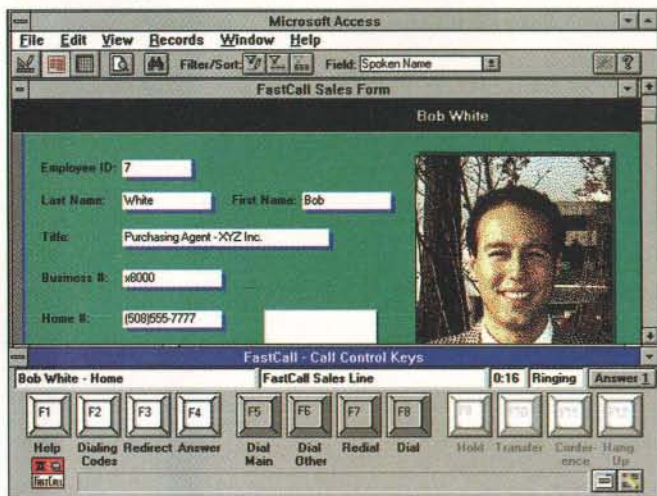
### Launch My Apps

Another way to enhance the network pipe is through off-the-shelf middleware, such as

FastCall from Aurora Systems. FastCall, which works with TAPI (telephony API) and TSAPI (telephony services API), endows almost any Windows application with telephony services, such as identification of incoming calls, creation of "screen pops" from customer records, and simulation of a phone's button functions on a computer display.

FastCall uses the identification of incoming calls to trigger functions selectively within Windows applications. For example, a call from a certain contact can be linked to a record in Lotus Organizer so when that contact calls, FastCall launches Organizer and pops the contact's record on the screen. Or the program can be trained to bring up a spreadsheet program or a personal finance manager when a bill collector calls. Or you can set it up to launch Tetris whenever a certain long-winded acquaintance calls.

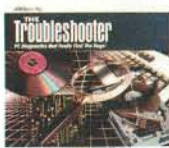
FastCall has killer app potential because it works across a broad array of switching equipment, APIs, and applications, and it's transparent to the user. According to Paul Gasparro, CEO and cofounder of Au-



Aurora Systems' FastCall endows Windows applications with telephony services. This screen shows a call-center telephony application. The program uses identification of incoming calls to trigger functions, such as popping up a contact record.

# Fix Any PC...FAST!

## PC DIAGNOSTICS THAT REALLY FINDS THE BUGS!



The Troubleshooter™ is the most advanced PC diagnostic software available that really finds the bugs. The Troubleshooter bypasses DOS & tests all major hardware components directly for true accuracy. Works with Windows, Windows NT, Windows 95, Novell, MS DOS,

OS2, etc. — fully O/S independent. Loaded with all the tests you'll need to accurately isolate the source of PC failures. Priced far below all competitors. Call now for full list of latest features! **New Upgraded Version!**

## #1 WINDOWS TROUBLESHOOTING TOOL!



Skylight™ is the #1 rated Windows diagnostic (PC Magazine) that tunes optimizes & troubleshoots Windows for maximum speed and performance. Edits all .INI files safely. Graphically displays how Windows is using memory, system resources, system metrics, G.D.I.

heap usage plus much more with hundreds of reports! A must for all Windows users! Call now for full list of features!



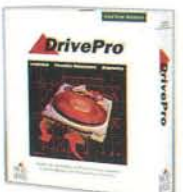
## GET DATA BACK FROM CRASHED DRIVES!



rescued drives. Be prepared for any problem. RESCUE is the insurance and security you need to safeguard your valuable data. Call now! Don't wait until your data is lost!

RESCUE Data Recovery Software™ is the only program to easily recover lost data from crashed floppies & hard drives even when DOS can't read them! RESCUE recovers data other recovery programs cannot. RESCUE automatically recovers DOS & Windows files including data from compressed drives.

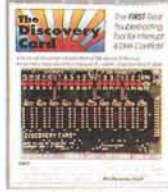
## FIX OR INSTALL ANY HARD DRIVE...FAST!



drives with MFMRLL or ESDI drives in the same system. Retrieves the manufacturers' recommended specs from the drive itself, plus much more! Call now for full list of features!

DrivePro™ provides fast, precise installation and maintenance for any hard drive. Override BIOS limitations for user-definable drive types. DOS format any size hard drive in under 30 seconds. IDE drives can be installed in less than 60 seconds. Allows the use of IDE

## RESOLVE ANY IRQ OR DMA CONFLICT...100%



alone cannot detect DMA conflicts! Call now, save time when reporting IRQ conflicts! Call now, save time and end the frustration! **Winner 1995 Top Diagnostic Tool - Windows Magazine**

The Discovery Card™ is the first tool to accurately resolve any IRQ or DMA conflict. 18 L.E.D. lights (11 for all interrupts and 7 for all DMA) immediately report actual usage thus saving time when configuring, upgrading or debugging PC's. Software



## Free Technical Support Next Day Shipping

## Performance Guaranteed

**(800) 653-4933** BM



International: (813) 539-7283 • Fax: (813) 531-0200  
BBS#: 813-535-9042 • Internet: ALLMICRO@IX.NETCOM.COM

**AllMicro, Inc.**

18820 U.S. Hwy 19 N, #215, Clearwater, FL 34624

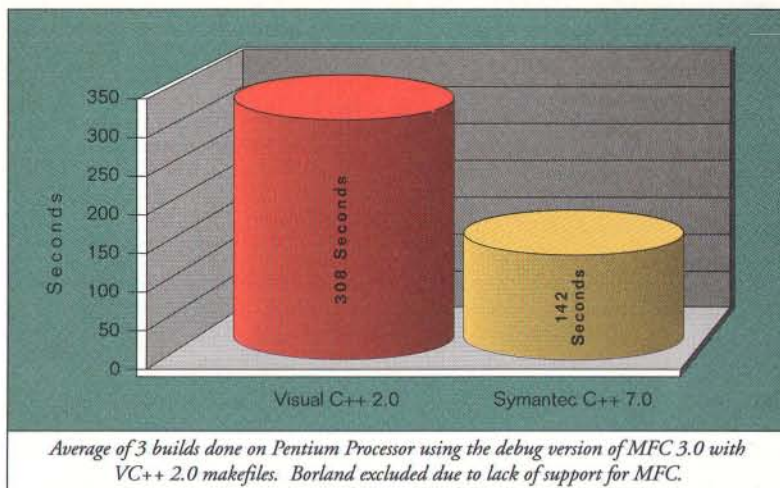
© 1995 AllMicro, Inc. Fix Any PC Fast, Rescue Data Recovery Software, The Discovery Card, and The Troubleshooter are trademarks of AllMicro, Inc. All Rights Reserved. Other names are trademarks of their associated owners. Specifications subject to change without notice.



Imagine roaring through the development process in a fraction of the time it takes with Microsoft Visual C++ or Borland C++. All you need is new Symantec C++ 7.0 with full support for Windows 95 Preview Program, Windows NT 3.5, Windows 3.1 and DOS.

## THE FIRST TRULY OBJECT-ORIENTED C++ ENVIRONMENT.

Symantec C++ 7.0 is the only C++ that lets you architect and navigate your application with a dynamic Class Editor and graphical Hierarchy Editor. This



6.0 – the world's fastest linker.

For building great Windows

and Debugging Environment (IDDE) provides the most powerful debugging

# ARCHITECT. NAVIGATE. BUILD. DEBUG. NEW SYMANTEC C++ 7.0 IS THE FASTEST WAY TO DO IT ALL.

great new system incrementally parses your C and C++ code and displays an up-to-date structural model of your program without compiling. But that's only the beginning. It also lets you modify any class's inheritance graphically. Plus it automatically locates any class implementation, and much more!

## THE NETBUILD REVOLUTION.

Now you can build applications faster than you've ever imagined. With the new NetBuild™, you can automatically distribute the build process over multiple computers on your LAN, dramatically reducing build times.

In addition, AppExpress™, ClassExpress™, and ProjectExpress™ give you Wizard-like functionality to boost your productivity.

And to make your link-cycle lightning-fast, there's new 32-bit OPTLINK®

resources easily, we've added ResourceStudio – the new OLE 2.0-based resource editor that supports the widest range of Windows resources including Windows 95.

## POWER DEBUGGING FOR WINDOWS 3.1 AND NT.

Symantec's Integrated Development

### CLASS EDITOR AND HIERARCHY EDITOR

dramatically increase your productivity.

### NETBUILD

distributes the build process across networked resources for the fastest build times.

### SUPPORT FOR WINDOWS 95

Preview as well as Windows NT 3.5, Windows 3.1 and DOS.

### APPEXPRESS, CLASSEXPRESS AND PROJECTEXPRESS

automate time-consuming tasks.

### OPTLINK® 6.0

is the fastest linker in the world.

### IDDE WITH 16 AND 32-BIT DEBUGGING

for Windows 95 beta, NT 3.5 & Windows 3.1

features including Thread View, Inspector View, hardware watchpoints and low-level debugging.

Of course, all of these productivity-boosting tools are integrated with a language that supports key standards like ANSI C++ (exception handling, templates and RTTI) and NT structured exception handling. And unlike Borland, Symantec supports MFC and includes it free.

In short, no other C++ lets you do it all this fast. Call the toll-free number below and see for yourself.

### FREE DEMO CD

See how Symantec C++ 7.0 architects, navigates, builds and debugs faster than any other C++.

Call 1-800-628-4777 and ask for Extension 9AP3 now for your free demo CD and the name of the Symantec dealer nearest you.



# SYMANTEC®

Offer valid in U.S.A. only. For more information in Canada, call 1-800-667-8661, ext. 5513. In Australia, call 2-879-6577. In Europe, call 31-71-353111. Symantec, NetBuild and OPTLINK are trademarks and registered trademarks of Symantec Corporation. All other trademarks are the property of their respective holders. All rights reserved. Developers wishing to use Windows 95 Preview Program files must sign a beta agreement with restrictions for the use of those files. © 1995 Symantec Corporation.



# STATE OF THE ART Telephony's Killer App

rorra, FastCall is becoming the standard for CTI middleware. "If you go to a major switch company, they'll supply you with TAPI or TSAPI and FastCall," Gasparro says. "The reason it's being adopted as a standard is because it takes all the pain out of computer telephony integration. Before FastCall, it would normally take six months to get CTI working. With FastCall, it takes less than four hours."

## And the Winner Is ...

Any of these apps might turn out to be the one that makes the difference. Wildfire is certainly the most glamorous, but its future isn't guaranteed (see the text box "Wildfire: One Wild and Not-So-Crazy Helper" on page 216). PhoneNotes has a lot going for it, including widespread corporate acceptance of its parent product, Notes, and the marketing impetus likely

to result from IBM's takeover of Lotus. Either one could dramatically change our daily work habits. VoiceView is a less drastic step that is likely to open new doors for integrating data into our phone habits.

Or maybe the killer app will come from somewhere else. Novell's NetWare Telephony Services offers an attractive model for unified messaging, but its \$15,000 price could keep it out of many organizations.

Whenever the killer telephony app arrives, however, one thing is certain: It will pay close attention to the human side of the technology equation.

"This is about social change, not just technology change," observes Michalski of Release 1.0. "CTI isn't about plugging a computer into a telephone. CTI is about making life easier for people who want to communicate." ■

*John P. Mello Jr. is a freelance writer living in Woonsocket, Rhode Island. You can reach him on the Internet as JPMjr61750@aol.com or on BIX c/o "editors."*

## XRT Widgets

With XRT Widgets you will build better Motif applications faster, easier, and more cost-effectively than ever before.

Today over 20,000 developers worldwide use these award-winning components to build interactive charts, graphs, tables and data-entry forms into their Motif applications.

You can program XRT Widgets using resource files and the standard Xt/Motif API, or integrate them with any popular GUI-builder tool or C++ environment.

XRT Widgets are available today on over 15 UNIX/VMS architectures and more XRT Widgets are being released all the time, including versions for Windows, NT, Galaxy and Japanese UNIX.

Call KL Group or your local reseller today to start your free 30-day evaluation.

**FREE 30-DAY EVALUATION**  
(800) 663-4723



**KL GROUP**

(416) 594-1026 Fax (416) 594-1919  
info@klg.com <http://www.klg.com/>

XRT is a registered trademark and XRT/3d, XRT/field, XRT/graph, and XRT/table are trademarks of KL Group Inc.

## Product Information

**FastCall** ..... \$200-\$600  
Aurora Systems  
Acton, MA  
(508) 263-4141  
fax: (508) 635-9756  
**Circle 1145 on Inquiry Card.**

**NetWare Telephony Services** ..... \$15,000  
Novell  
Provo, UT  
(800) 638-9273  
(801) 429-7000  
fax: (801) 429-5155  
<http://www.novell.com>  
**Circle 1146 on Inquiry Card.**

**PhoneNotes Application Kit** ..... \$695  
Lotus Development Corp.  
Cambridge, MA  
(800) 343-5414  
(617) 577-8500  
fax: (617) 693-3512  
<http://www.lotus.com>  
**Circle 1147 on Inquiry Card.**

**VoiceView**  
(bundled with compatible modems)  
Radish Communication Systems  
Boulder, CO  
(800) RADISH8  
(303) 443-5789  
fax: (303) 443-1659  
**Circle 1148 on Inquiry Card.**

**Wildfire** ..... \$50,000/24 users;  
\$100,000/50 users  
Wildfire Communications  
Lexington, MA  
(800) WILDFIRE  
(617) 674-1500  
fax: (617) 674-1501  
**Circle 1149 on Inquiry Card.**



RUSH HOUR,  
AS DESIGNED BY NETWORK  
PROFESSIONALS.



TCP/IP CONNECTIVITY,  
AS DESIGNED BY  
NETWORK PROFESSIONALS.



Now, Windows users move freely wherever they need to go with the Reflection Network Series® version 5.0 from WRQ.

This is TCP/IP connectivity created with your needs in mind, from providing smooth access to corporate computers to touring global information networks. This enhanced new version offers all the transport protocols, powerful applications, and an exceptionally reliable TCP/IP stack.

It even includes management and diagnostic tools that put you in control, and specialized features for mobile/wireless computing.

Call today and try it. Your network performance could rise to a whole new level.



#### REFLECTION NETWORK SERIES®

- ▲ **PROTOCOLS:** TCP/IP, UDP/IP, NS/V, LAT, IPX/SPX, NETBIOS, SLIP/CSLIP
  - ▲ **APPLICATIONS:** NFS WITH OLE SUPPORT, FTP, TFTP, LPR/LPD, FINGER, PING, INTERNET APPLICATIONS
  - ▲ **NETWORK MANAGEMENT TOOLS:** SNMP MIB II, PRIVATE MIB, EVENT LOG/VIEWER, TRACE ROUTE, DHCP, BOOTP, RARP
  - ▲ **COOPERATIVE VxD/DLL DESIGN WITH 100% WINDOWS SOCKETS COMPATIBILITY**
- WRQ OFFERS REFLECTION PC-TO-HOST CONNECTIVITY FOR UNIX, X, DIGITAL, HP, AND IBM SYSTEMS**

**Argentina**—TCW Argentina S.A. (1) 314 5010 **Australia**—Megatec Pty. Ltd. 1 800 806 563  
**Austria**—SIS Informationstechnologie Ges.m.b.H (01) 376316112 **Benelux**—Computing &  
 Systems Consultants bv (040) 43 49 57 **BMC Software Services** (070) 360 68 60 **Brazil**—  
 Brazil Software (021) 533 1726 **Nutec Informática S.A.** (011) 505 5728 **Chile**—Digital  
 Equipment America Latina (2) 671 8161 **S & A Consultores** (2) 235 0289 **Czech Republic**—  
 INSEKO CS (067) 607 311 **Denmark**—Tempest Europe ApS 4494 8902 **Finland**—  
 TT-Professional Solution Oy (90) 502 7612 **France**—ADE (Toulouse) (16) 61 73 32 49  
**Germany**—GFKT Wick Hill GmbH (040) 23 73 01 0 **Hong Kong**—G.T.I. 2753 8283 **Ireland**—  
 Entropy Ltd. (01) 2940199 **Israel**—Lihad/Bina Systems Ltd. (03) 557 3636 **Italy**—Siosistemi srl  
 (030) 24411 **Japan**—Cybernet Systems (03) 5978 5410 **Malaysia**—SCS Computer Systems Sdn.  
 Bhd (03) 756 5800 **Mexico**—Infosistemas Financieros (5) 813 1325 **New Zealand**—Interconnect  
 (09) 358 0322 **Norway**—Nocom Norge A/S 67581450 **Poland**—Softkom Sp. z o.o. (2) 6356346  
**Portugal**—Silicon (01) 795 85 85 **Singapore**—ST Computer Systems & Services Ltd. 441 2688  
**Slovak Republic**—INSEKO a.s. (089) 64 88 08 **South Africa**—LAN Design (011) 444 1050  
**Spain**—Scorpion Sistemas SA (93) 485 40 44 **Sweden**—Nocom AB (018) 65 55 00  
**Switzerland**—Commcare (01) 730 24 31 **United Kingdom**—Wick Hill Ltd. (01483) 772280  
**Venezuela**—Lanka Sistemas (2) 959 2411

**WRQ Reflection**  
CONNECTIVITY FOR A CHANGING WORLD

WALKER RICHES & QUINN, INC. / 1500 DEXTER AVENUE NORTH, SEATTLE, WASHINGTON 98109 USA / FAX: 206.217.0293  
 ▲ BUITENHOF 47, 2513 AH DEN HAAG, THE NETHERLANDS / FAX: +31.70.356.12.44 ▲ WILHELM-MARK HAUS, HEINRICH-HEINE ALLEE 53,  
 40213 DÜSSELDORF, GERMANY / FAX: +49.211.8307 360 ▲ LE DÔME, BP 10910, 1 RUE DE LA HAYE, 95731 ROISSY CDG CEDEX,  
 FRANCE / FAX: +33.1.49.19.22.16 ▲ WRQ AND REFLECTION ARE REGISTERED TRADEMARKS OF WALKER RICHES & QUINN, INC.  
 ALL OTHER TRADEMARKS ARE THE PROPERTY OF THEIR RESPECTIVE HOLDERS.

Circle 91 on Inquiry Card.



# NobleNet: The Standard For Easy-to-Use Development-Tool Middleware

**NOW**  
For Distributing  
Both APIs  
and Objects

## **EZ-RPC For Distributed APIs: The Truly Multi-platform RPC**

- ▲ EZ-RPC supports partitioning APIs among heterogeneous platforms and distributing remote APIs from UNIX to Windows with automatic conversion of C APIs to Windows DLLs
- ▲ EZ-RPC integrates distributed applications with industry-standard APIs such as WinSock, ODBC, and XFN
- ▲ EZ-RPC's patented memory management algorithms allocate and free memory for inherently stable server code and to protect against client-side memory leaks
- ▲ EZ-RPC XDR libraries support passing of complex data structures; only implementation of ONC RPC library on Windows 3.1, NT and Macintosh

## **Orbix For Distributed Objects: The Original CORBA-Compliant ORB**

- ▲ Orbix includes complete development environment for managing multi-platform fine-grained objects
- ▲ Orbix includes Implementation Repository and advanced administrative tools such as a stream-based Dynamic Invocation Interface
- ▲ Orbix provides programmable client-transparent proxies for performance improvement
- ▲ Orbix features process-level filters to integrate thread packages, monitoring and debugging, auditing and authentication/authorization/encryption support
- ▲ Orbix provides full implementation of CORBA 1.1 standard

Both create portable lightweight middleware that travels with the application. There's no need to change or upgrade systems when you roll-out applications. NobleNet products protect developers from complex network coding, distribute C and C++ code, support fast code partitioning for rapid prototyping with tools such as Visual BASIC and PowerBuilder, and operate across TCP-IP and IPX/SPX stacks. ONC and CORBA compliant. Works on all the key platforms: From and to AIX, DG/UX Digital UNIX, HP-UX, Macintosh, NetWare, NeXT, OpenVMS, OS/2, Pyramid, SCO-UNIX, SGI, Siemens-Nixdorf, Solaris, Stratus, System V Rev.4, Sun/OS, UNIXware, VxWorks, Windows 3.x and Windows NT. As clients and servers.

Copyright © 1995, NobleNet Inc.  
Product names are trademarks or registered trademarks of their owners  
NobleNet is a North American distributor of IONA Technologies' Orbix product.

*Call Today For  
No-Obligation Evaluation Copy!*

**1-800-809-8988**



**NobleNet**

NobleNet, Inc., 337 Turnpike Rd., Southboro, MA 01772  
508-460-8222 FAX 508-460-3456  
E-mail: sales@NobleNet.com



JON UDELL

# WEB SEARCH

**T**hink the Web is too vast to search? I did, but index-and-search engines such as Carnegie Mellon University's Lycos (<http://lycos.cs.cmu.edu/>) and the University of Washington's WebCrawler (<http://webcrawler.com/>) proved me wrong. These robotic indexers ceaselessly read and catalog Web pages, and they have so far kept up remarkably well with the Web's explosive growth.

They take simple queries—a single term or several ANDed together—and return lists of URLs that could oth-

erwise take you months of point-and-click navigation to assemble. They typically don't do proximity searches (word 1 within so many words of word 2). But InfoSeek (<http://www.infoseek.com/>), a commercial service, does. And the WAIS Inc. server (<http://www.wais.com>) that powers a number of Web sites can even handle natural-language queries like What is the capital of Peru? For an example, see Encyclopedia Britannica at <http://www.eb.com>.

As good as Web search tools are, when you ask a specific question—How do I walk a directory tree in Perl? or What's the cheapest laser printer with network support for IP, IPX, and AppleTalk?—you likely won't find an answer in a hurry, and you may not find one at all. Brute-force searching, even at its best, yields hordes of false positives—documents that contain the keywords, even perhaps in close proximity, but have nothing to do with the question.

Information providers can help by categorizing documents, so users can look for how-to articles on Perl or reviews of network-ready laser printers. As we move BYTE's content into electronic media, we'll try to provide such clues. But will our categories match those used by other computer magazines? By book publishers? By people who post to Internet newsgroups? As the Web absorbs and extends the world's libraries, authors and editors will find that proper classification of their contributions to the Web will make those documents easier to find and, hence, more valuable. My advice to major Web contributors (and to creators of Web authoring tools) is to hire a library scientist.

## Basic Indexing

While you're waiting for a Web equivalent of the Dewey decimal system, you might as well go ahead and add basic indexing to your Web site. Because we're running Windows NT, the EMWAC (European Microsoft Windows NT Academic Consortium) WAIS (Wide Area Information Servers) server and toolkit were the logical place to start. These tools are NT ports of freeWAIS; you can get

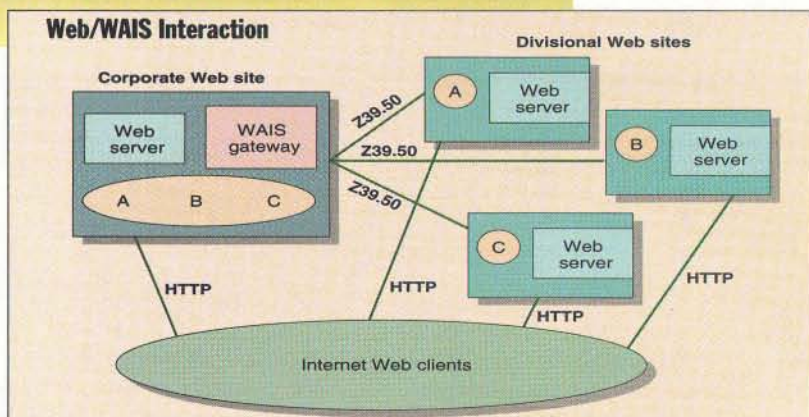
## What About WAIS?

WAIS (Wide Area Information Servers) predates the Web craze; since 1991, people have used its Z39.50 protocol to search a variety of databases on the Internet. Could WAIS clients bypass BYTE's Web server and search the collection directly? I found a pair of them (WinWais at <ftp://ftp.einet.com> and WaisMan3 at <ftp://ftp.cnidr.org>), started the WAIS service on my NT server, and pointed the clients at it. They worked. But so what? Hardly anybody uses WAIS clients because most WAIS databases have gateways that export Web-style access.

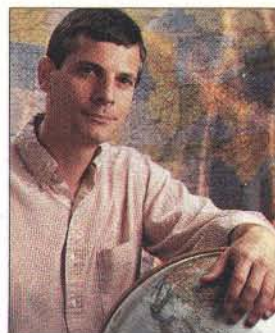
Still, a client/server protocol for searching remote databases ought to be useful. John Duhring, a WAIS Inc. vice president, showed

me that it is. With WAIS tools, he says, Web providers can uniformly present information drawn from remote Web sites.

Consider The McGraw-Hill Companies, BYTE's parent. Many of its companies are building Web sites. With conventional Web technology, the corporate Web site can refer visitors to divisional sites—but they might never come back. If, on the other hand, BYTE and others run both Web and WAIS servers, and corporate runs both a Web server and a WAIS gateway (see the figure "Web/WAIS Interaction" below), the divisions can appear as players in corporate's virtual theater. Meanwhile, divisional Web sites accessed directly can retain their own flavor.



With a WAIS gateway, a central Web site can consolidate many remote sites into a single presentation.



AL KARNEY © 1995

**It's easy to index a Web document collection so visitors can search your site. Here are a couple of ways to do it.**



Intel, Mips, and Alpha versions of them from various places including Microsoft (the Windows NT Resource Kit CD), EMWAC (<http://emwac.ed.ac.uk> or its mirror sites), and Process Software (<http://www.process.com>). Versions of freeWAIS for many Unixes are available from CNIDR (the Clearinghouse for Networked Information Discovery and Retrieval) at <ftp://ftp.cnidr.org>.

The tools come in two packages: wsXXX.zip for the WAIS server and wtXXX.zip for the WAIS toolkit. (Replace XXX with your CPU: i386, Mips, or Alpha.) I grabbed both programs from Process Software's site, thinking that I'd need the toolkit to create indexes and the server to access them. As it turned out, I really needed only the toolkit. It contains both the indexer and a query tool that searches an index and returns an HTML-formatted report listing URLs for documents matching the search. What's the WAIS server for? It enables WAIS clients to bypass your Web server and access your indexed document collection directly, using the WAIS Z39.50 protocol (see the text box "What About WAIS?" on page 223).

You'll need long filenames to use waisindex, the tool that does the indexing. Prior to NT 3.5, that meant you had to run it on an NTFS volume, but now that NT 3.5's FAT (file allocation table) supports long names that's no longer a problem. Here's the command I used to index the January 1994 issue of BYTE:

```
waisindex -d index -r -a -T html
art\9401\*.htm
```

where -d names the index, -r tells the indexer to recursively index subdirectories, and -a appends to an existing index. First time through I skipped the -T html option. When I searched the resulting index, what came back were filenames, not document titles. That meant the search results were cryptic references like "art\9401\sec9\art7.htm" instead of more helpful ones like "January 1994 / Reviews / Low-Cost Laser Printers."

Since the translator that creates our HTML files writes the latter style of reference in the <title> field of every article's HTML header, adding -T html was the quick fix. However, it prompted me to reconsider my sequentially generated URLs (see the text box "8.3 Brain Damage" above).

Once you've got the index built, it's a snap to connect Web clients to it. If you

## 8.3 Brain Damage

If you're generating HTML mechanically, why not simply create long filenames, so that URLs themselves carry the information stashed in the HTML header (e.g., "January\_1994/Reviews/Low-Cost\_Laser\_Printers.html")? That I didn't think of this at first shows the brain damage caused by years in the mental prison of the DOS 8.3 filename.

It's nice for URLs to be descriptive, but it's not necessary. What is

essential is that they're unique and immutable. My scheme, which just enumerates sections and articles, guarantees uniqueness—there will be only one art\9401\sec9\art7.htm in the collection. But will that URL immutably refer to the January '94 review of laser printers? Not if we find that we've forgotten to include another January '94 article and then decide to regenerate the collection. Uh oh. Everything gets renumbered.

This isn't a problem for Web site users because the navigation and search functions adjust to the new structure. But if you've saved a bookmark to art\9401\sec9\art7.htm, you'll be upset if I renumber the collection.

I'm not aware of gaps in the 1994 collection that's on the Web now, and I don't expect we'll need to renumber it. But I do want to try using descriptive URLs for 1995 and future content.

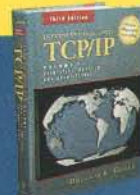
### TOOLWATCH



**Diskeeper for Windows NT, Workstation, \$199  
Server, \$399  
Executive Software  
(818) 547-5407**

You can't shut down a busy Web server to defragment its disk. Here's the answer: an elegant defragging tool that runs on a background thread and can even schedule itself for periodic execution.

### BOOKNOTE



**Internetworking with TCP/IP, 3rd edition, \$52  
by Douglas Comer  
Prentice-Hall, 1995  
ISBN 0-13-216987-8**

Updated with new material on security, IPng, and ATM. Comer's lucid tutorial on Internet plumbing continues to top the charts.

created an index named "index," you can create a form enabling users to search it by simply writing the keyword <isindex> in an HTML document called INDEX.HTM. When viewed in a browser, this document displays the familiar search form "This is a searchable index. Enter search keywords." When the user enters a search term, the Web server passes it to waislook, a program that searches the index and returns HTML-formatted results.

On a pair of NT boxes running

EMWAC-derived Web servers—a 486 with Folio's Infobase Web Server, and an Alpha with Process Software's Purveyor—these procedures yielded the searchable archive that I'm currently testing. It works, but since multiple search terms combine with OR rather than AND, and there's no phrase search ("SQL catalog") or proximity search ("SQL within/5 catalog"), you depend on the selective power of a single term. An unusual one, like "PnP" or "Z39.50," will often net just the right bunch of articles; that's what makes even this bare-bones indexing system incredibly useful. But it's really just a minimal solution.

### WebSite and SWISH

To improve matters on the 486 server, I turned to WebIndex, the tool that comes with O'Reilly & Associates' WebSite server for NT and Win 95. You launch WebIndex from WebSite's GUI administration tool, and it prompts you graphically for URLs to include in the index and begins indexing with a mouse click. Unlike waislook, WebSite's WebFind can at least join terms together with AND so that when you use multiple terms, the result set will shrink rather than grow. For small collections, it's just what it claims to be: a one-button indexer for non-nerds. But when I fed it several thousand documents, hours of disk thrashing ensued until I killed it.

What remained, from a previous run on fewer documents, was a file called index.swish. Swish? That's just the sort of oddball search term that gets great results on the Internet. A WebCrawler search led me to Enterprise Integration Technologies and the Simple Web Indexing



# Authoritative. Independent. Objective.

## Introducing the OpenView Advisor— from the editors of Data Communications

Corporate networkers who've made the move to OpenView know how tough it is to find the facts on the industry's leading net management framework. And the same goes for third-party developers looking to crack this lucrative market.

Despite all its support, HP hardly qualifies as an impartial source, and surfing the Internet is no way to

plan an effective enterprise management strategy.

### The industry's only publication devoted exclusively to OpenView

*OpenView Advisor* gives users and developers exactly what they need: a monthly, vendor-independent newsletter that's got the technical savvy to solve their most pressing

problems. Written and edited by the staff of DATA COMMUNICATIONS and some of the top consultants in the OpenView community, each issue is packed with in-depth analyses and hard-hitting technology reviews that can't be found anywhere else.

These features will make *OpenView Advisor* an indispensable tool for net managers and ISVs:

#### ANALYSIS

Industry experts detail and discuss OpenView trends and technical developments

#### TECHNICAL TUTORIALS

Step-by-step troubleshooting from users and developers who've overcome the toughest OpenView challenges

#### CASE STUDIES

Profiles of actual OpenView networks, with an emphasis on cost analysis, product selection, implementation strategies, and deployment issues

#### TECH TIPS

Concise, hands-on solutions to common OpenView problems from users, developers, and HP engineers

**PREMIERES  
FEBRUARY 1995**

#### DEVELOPER'S VIEW

A forum for application developers, system integrators, and third-party vendors

#### INTERVIEWS

No-holds barred discussions with key Hewlett-Packard engineers and product managers for the OpenView line

#### INTERNATIONAL ISSUES

Addresses the concerns of global networkers, including managing across WAN links, finding products and technologies, and integrating platforms

#### PRODUCTS

Exclusive coverage of new and upcoming products and services for the OpenView environment



### Take advantage of this one-time introductory offer from OpenView Advisor

Act now and become a charter subscriber to *OpenView Advisor* for the special price of only \$495 for 12 issues (\$595 outside North America).

That's a savings of \$100 off the regular subscription price. But you have to move quickly—this offer is available for a limited time only.

To order, call toll-free in the U.S.: 1-800-598-0474

To order outside the U.S. call: 615-377-3322

Fax orders to: 615-377-0525

Internet address: [openview@mcgraw-hill.com](mailto:openview@mcgraw-hill.com)

**Data  
Communications**



## The Road Traveled

In July's column we introduced a Web server on a dial-up PPP link, while awaiting installation of a 56-Kbps leased line. In August, we went live on the leased line, but the names [www.byte.com](http://www.byte.com) and [ftp.byte.com](http://ftp.byte.com) weren't hooked up yet. You could get to the server only if you knew its IP address. Now the names map to IP addresses, and we're officially open for business.

How did we register our name? We registered [byte.com](http://byte.com) with the InterNIC (Internet Network Information Center) years ago and used it for UUCP (dial-up) mail routing. Once we got a real IP link to the Internet, there were three ways to create the names [www.byte.com](http://www.byte.com) and [ftp.byte.com](http://ftp.byte.com) and define their IP mappings:

1. Leave naming authority for [byte.com](http://byte.com) in the hands of InterNIC and ask InterNIC to add our names to its database. (You do this by mailing a form to [hostmaster@internic.net](mailto:hostmaster@internic.net); the forms are available at <http://rs.internic.net/templates>.)

2. Delegate naming authority to our service provider MV Communications (again by mailing a form to [hostmaster@internic.net](mailto:hostmaster@internic.net)) and ask MV to add the names to its database.

3. Take over naming authority ourselves.

The problem with 1 is that there's a big administrative backlog at InterNIC, so we opted for 2. We'll likely want additional names, and we won't want to wait two weeks for InterNIC to handle each request—MV's far more accessible to us. Why not 3? In that case, we'd have to run our own name server. We aren't

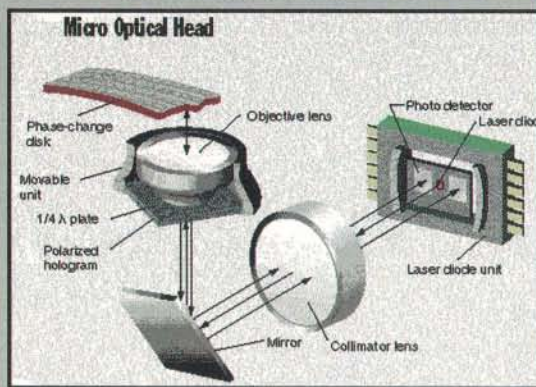
the mass market. "The optical industry in the past, except ability to shoot itself in the foot. [PD] may be the way to break

### The PD laser mechanism

[image \(15 Kbytes\)](#)

The PD laser mechanism is similar to that of a standard CD-ROM drive.

### The PD laser mechanism



The PD laser mechanism is similar to that of a standard CD-ROM drive.

In the BYTE collection, a link to an illustration reports the size of the image (a). Following the link leads not to a bare GIF file but to a document that wraps standard links, a headline, a caption, and a copyright notice around the image (b).

ready to do that yet.

"The wait is about a week for change requests," said MV's Mark Mallet, "and two weeks for new records." He requested the transfer of [byte.com](http://byte.com)'s name service from InterNIC to MV. A week later it was done. The command `whois byte.com` listed MV's name servers, ping [www.byte.com](http://www.byte.com) worked, and [www.byte.com](http://www.byte.com) was open for business.

### Magic Hot Links

When Netscape's news reader finds a string like <http://www.somewhere.com> in the text of a posting, it automatically converts that string into an active hypertext link. I've added this to BYTE's Web site with my Epsilon

Extension Language translator. It's one regular-expression search-and-replace statement:

```
string_replace(
  "((http|ftp|gopher)://\n
  <^tab><space><nl>\n
  ..more non-URL chars..",
  "<a href=#0#0</a>",
  REGEX);
```

A similar trick activates E-mail addresses that appear in the text.

### Well-Mannered GIFs

I hate downloading bit maps I didn't ask for. BYTE's server has plenty of pictures to offer, but it won't shove images down your throat. The translator now suppresses illustrations, photos, and screen shots behind links that announce the size of each GIF (see the screen above).

System for Humans, which is an alternative to freeWAIS. O'Reilly's WebIndex derives from version 1.0 of EIT's SWISH. I downloaded SWISH 1.1 from [ftp://ftp.eit.com](http://ftp.eit.com), compiled it on our BSDI 2.0 machine, and tried it. SWISH is tuned for HTML—e.g., it can index just fields tagged as titles or comments. It can also segment a large indexing job into many small ones, then merge the segments.

Since low memory was the likely cause of disk thrashing, I thought I'd try the merge option described in the SWISH 1.1 docs. No luck. WebIndex is a pure GUI tool that doesn't expose that feature.

O'Reilly put me in touch with EIT's director of Web publishing, Jay Weber. I ftp'd the archive to EIT, where Weber successfully indexed it with WebIndex on several test systems. EIT also added a progress meter to WebIndex that revealed speedy progress through 10 of 14 BYTE issues, then suddenly—molasses. Weber sent me a new, memory-optimized update (available at <http://website.ora.com> or [ftp://ftp.eit.com/pub/website](http://ftp.eit.com/pub/website)). It did work with my data.

### The Folio Alternative

Folio's Infobase Web Server is a completely different way to serve an indexed collection to the Web. It's an EMWAC-based Web server mated to the Folio Views search engine. That means it does everything that normal Web servers do, and it can also convert existing Views infobases to HTML on the fly. If you have infobases on hand, this is just the ticket. Even if you don't, this approach has a lot going for it. Views has a lightning-fast indexer, handles huge data sets, deals with hierarchical documents, and does phrase and proximity searches.

If you're a Views user, you can judge for yourself how well this Web converter reproduces Folio's Windows user interface. And while a series of retrieved Web pages clearly can't be as richly interactive or as responsive as a native application, this technique does inject client/server capability into Folio Views.

Visitors to the BYTE Web site have been trying all three search mechanisms. Folio and WebIndex are more popular than the less-capable freeWAIS, but freeWAIS is faster for single-term queries. Because effective use of the Web requires searching, I'll continue to explore these types of tools. ■

Jon Udell ([judell@bix.com](mailto:judell@bix.com)) is BYTE's executive editor for new media.



# LANNET WROTE THE *book on switching hubs.* Here are the *reviews.*

"LANNET's flexible, scalable, high-performance switching system is the stuff of network managers' dreams."  
LAN Times

"[LANNET] created a simple but ingenious feature that allows the switch to throttle back the source ports when the destination port is getting too much traffic."  
Data Communications

or dropping packets — even at full wire speed, they won't drop a single frame. In the

"Clearly, LANNET is building a superhub as well as an Ethernet switch...LANNET offers some very impressive technology, including a 1.28Gbps backplane in an 18-slot hub."  
PC Week

We're happy to report that our superior switching hubs are finally getting the attention they deserve for setting new standards in switching. But more important than



market for a switching hub? Take it from the experts. Get LANNET. With switching capabilities like ours, your

"LANNET's LANswitch hit full wire speed on all six ports tested without dropping any frames."  
Data Communications

what they do in the pages of magazines is what they do

to your network. Like boost an over-burdened 10BaseT so you can continue to freely add bandwidth-hungry users. And don't worry about overloading



network will enjoy a long and productive life, and you'll soon be writing your own



The MultiNet hub with LANswitch™ modules lets you switch up to 128 dedicated 10 Mbps Ethernet connections.

success story. Before switching hubs, read our book. It's free!

Call: +972 (0)3 645 8458.

## LANNET

The Open Framework for Network Solutions.



LANNET Inc., Irvine, CA U.S.A. Tel: +1 (714) 752-6638, Fax: +1 (714) 752-6641 LANNET France., Orsay Cedex, France Tel: +33 1.69.33.24.80, Fax: +33 1.69.33.24.90  
LANNET UK Ltd., Oxford, United Kingdom Tel: +44 (0)1865-784666, Fax: +44 (0)1865-784669  
LANNET BV, Rotterdam, Holland Tel: +31 (0)10-202 28 99, Fax: +31 (0)10-447 03 62 LANNET Asia Ltd., Wanchai, Hong Kong Tel: +852 2866-6861, Fax: +852 2804-1881  
LANNET China, Beijing, China Tel: +86 10-592-7388, Fax: +86 10-502-2992 LANNET do Brasil, São Paulo-SP, Brazil, Tel: +55 11 532 2840, Fax: +55 11 532 2888  
LANNET Data Communications Ltd., Tel Aviv, Israel Tel: +972 (0)3-645 8458, Fax: +972 (0)3-648 7146  
©1994 LANNET Data Communications Ltd. MultiNet and LANswitch are registered trademarks of LANNET. All other trademarks are the sole property of their respective companies.  
Developer tested only. Novell makes no warranty with respect to this product.



# Not One More Damn Line of Code. Ever.

**New!**  
Build  
**WINDOWS95**  
Apps Today!

See How **LAYOUT** Lets You Build Real, Heavy-Duty Programs Without Writing a Single Line of Code. **Free.**

PC Week called Layout a "sure thing." We call it a revolution. With over 200,000 users, tons of add-ons, and widespread third-party support, Layout is the only tool that lets you build DOS or Windows programs by manipulating objects on screen — without writing code. Not just simple programs, but real, heavy-duty, mission-critical applications.

## The True Power of Objects

Layout is truly object-oriented, both in the programs it creates, and in how you use it. You start out by arranging objects in a simple diagram, and then add more objects as the program grows, or create new objects by combining existing ones. You can even run your program as you're building it. Data-entry, database, and report formats are all visually designed on-screen.

## What Layout Delivers

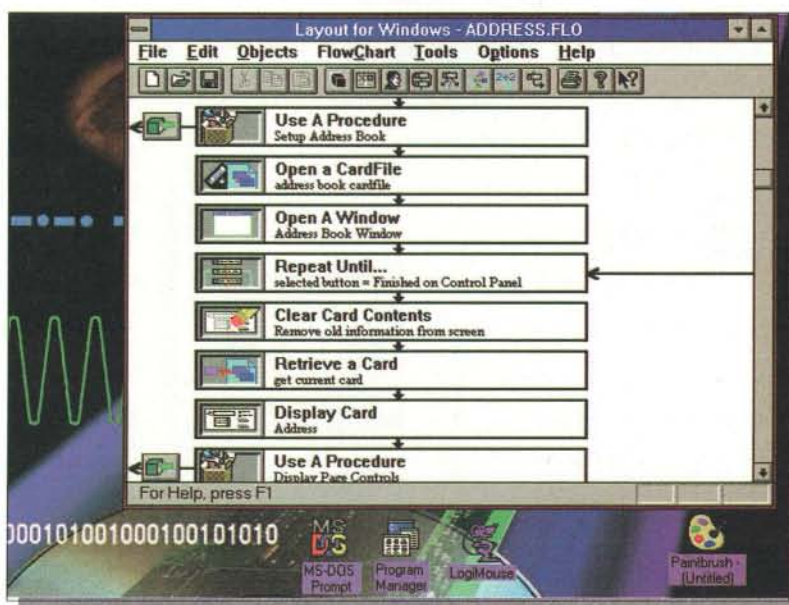
When you're done, Layout creates real .EXE files, or well-structured and efficient C/C++, Pascal, or BASIC programs. You can even create new objects right in Layout, or even re-use existing source code. Layout supports DOS and Windows, with NT and OS/2 coming soon, and applications written on any of these platforms are automatically portable to

the others — including Windows 95 (Chicago).

## Visual Power, Incredible Performance

The programs Layout creates are com-

Objects, Inc. is offering a **free Windows95 Toolkit** with Layout so you can start building tomorrow's programs today!



## Layout: the Ultimate Tool

Layout delivers the future for \$299.95, including everything you need to build programs; free, unlimited, technical support; and superb documentation. Call today, join the Layout revolution, and never see code again. **Ever.**

**Free!**



**LAYOUT APPLICATIONS SAMPLER**

**800-424-6644**

# Objects, Inc.

99 Rosewood Drive • Danvers, MA 01923 USA  
USA 508-777-2800 FAX 508-777-0180  
Email [info@objectsinc.com](mailto:info@objectsinc.com)  
Australia 07-855-2333 FAX 07-855-2364  
New Zealand 64-3-442-7754 FAX 64-3-442-7822  
Italy 39-864-210-691 FAX 39-864-210-689



# Gateways to the Internet

**America Online, CompuServe, and Prodigy offer Web browsers, FTP, and more, but these services aren't for everyone**

**GEORGE BOND**

**A**ccess to the World Wide Web may seem an obvious component of any major on-line service, but the Big Three—America Online (or AOL), CompuServe, and Prodigy—are just now scrambling aboard the bandwagon. All three offer something you don't get from an ISP (Internet service provider): a single point of access for Web surfing, commercial database browsing, and on-line conference discussions. They also deliver single-source access to technical support and training.

## The ISP Advantage

All these service providers—with the possible exception of Prodigy—tend to be more expensive than ISPs (see the text box "Convenience, but at What Price?" below). And the speed of phone connections to the Big Three is still mostly limited to 14.4 Kbps, a drawback when working with the on-line graphics of the Web.

Also, the three providers promise to upgrade their networks, but at the time of this writing only a few 28.8-Kbps connections were available. In contrast, many ISPs offer 28.8 Kbps routinely. But these shortcomings may be offset by the large number of POPs (points of presence, or local phone numbers) offered by the Big Three, as well as by the convenience of one-stop access to

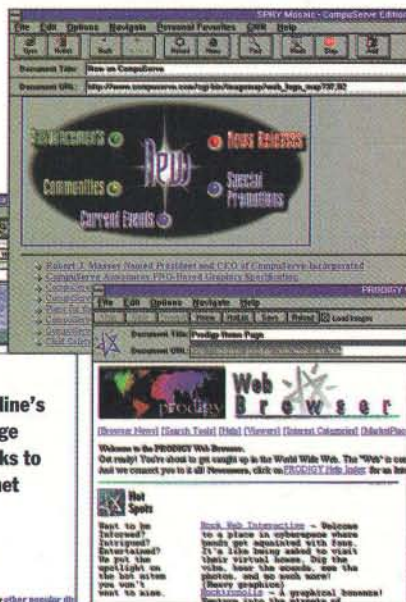
services and support.

Prodigy is the only major information provider currently with an actual Web service. At this writing, CompuServe and AOL were still in beta testing with their Web browsers (graphical front ends for navigating the Internet and viewing Web pages) and Web services. However, users of these providers' services can walk the Web now by downloading the necessary software. Internet mail, FTP (the Internet's file transfer protocol), and Usenet news groups are already in place.

## Web-Crawling with CompuServe

CompuServe uses the Spy Mosaic browser, TCP/IP stack, and dialer (the company purchased Spy to obtain the technology, as AOL did with InternetWorks and its browser). There are so many free sign-up

**CompuServe's What's New**  
page links users to popular new sites on the Internet.



**Prodigy's Welcome screen is the first thing you see when you jump to the World Wide Web.**

deals floating around that this initial expense will be nil, or close to it.

Once you're logged on to CompuServe, you use the command `go ppp` to get to the browser-downloading area. Then you either walk through menus to download the Windows version of the software or read instructions on how to connect via third-party Macintosh and OS/2 software. If you are using CompuServe's WinCim or

## Convenience, but at What Price?

**Using the Big Three commercial information providers can be expensive. Here's what it would cost to surf the Internet for 30 hours per month with each of them.**

**AOL (America Online).** The first 5 hours are included in the \$9.95 monthly fee. You're then charged \$2.95 for each of the remaining 25 hours. Total: \$83.70.

**CompuServe.** An initial charge of \$9.95 includes unlimited use of basic services and 3 hours of Internet services (i.e., World Wide Web, FTP, telnet, and the Usenet news reader). An additional charge of \$15

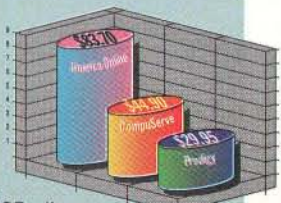
gets you an Internet Club membership with 17 more hours of connect time; each of the remaining 10 hours costs \$1.95. Total: \$44.90.

**Prodigy.** You get 30 hours of connect time under the 30/30 Plan. Total: \$29.95.

To be fair, these comparisons aren't strictly parallel; CompuServe also has a mail surcharge (10 cents for the first 7500 words and 2 cents for each additional 7500 words per message) if you exceed approximately 90 three-page, full-text messages a month. But time spent in mail is not counted toward connect

charges. The other services don't have a mail surcharge; they account for mail in their regular connect-time charges.

By comparison, ISPs (Internet service providers), companies that offer gateways to the Internet but rarely any local databases, have charges ranging from about \$20 to \$30 for 20 to 40 hours of access via 28.8-Kbps or slower modems, plus a dollar or two per hour for additional time.





## Turning an Ugly Duckling into a Hollywood Swan

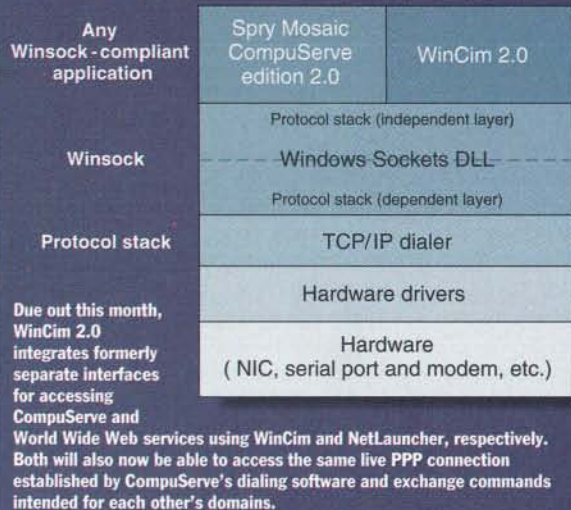
To seamlessly integrate the World Wide Web into its existing service, CompuServe faced two technical challenges: supporting the Internet protocols and getting the software front ends (i.e., the CompuServe access software and the Web browser) to talk to each other. Last spring, CompuServe delivered a downloadable Web browser, called NetLauncher, that could work from within a PPP (i.e., standard Internet) session established by the dialer built into the WinCim 1.4 interface. But if you'd already used WinCim to dial into CompuServe, you had to disconnect before dialing the PPP session.

The latest upgrade to CompuServe's Windows shell, WinCim 2.0, lets you dial a single phone number and toggle between any Web browser and the CompuServe interface in the same session. The improved integration is principally due to the Windows Sockets, or Winsock, DLL. Winsock presents a network-independent interface between Winsock-compliant applications. This interface sits on top of a network-dependent component that supports the specific networking protocol stack (usually, TCP/IP).

For the new version of WinCim, CompuServe programmers wrote a Winsock networking layer for both NetLauncher and WinCim. Both the Web browser and the CompuServe front end now hook into the Winsock API. This result is point-and-click access to both NetLauncher (or any other Winsock-compliant Web browser) and CompuServe.

CompuServe has also met the challenge of different software commands by adding translation algorithms to the mix. NetLauncher and WinCim can now talk each other's lingo. For instance, when a user types `go politics` in NetLauncher, it recognizes the command as being intended for a CompuServe Go page and passes the command in a message to WinCim.

### Where Winsock Fits In



Navigator software, you simply point and click to download the browser.

You run a single executable to install the software. If you already have a TCP/IP stack installed, CompuServe's stack will rename your stack and install its own. Your existing Internet client software probably will work with the new stack.

If you've seen Spry's Mosaic browser elsewhere (in the Internet-in-a-Box package, for example), you'll immediately recognize CompuServe's: It has the familiar menu bar and line-of-control buttons along the top of the screen, two long boxes in which you enter URLs (uniform resource locators, which are simply Internet addresses), and the familiar Spry globe for indicating when data is being transferred.

The browser defaults to the CompuServe home page on connection. You have three choices for navigating the Web: Clicking

on one of the hot links on the screen, selecting a location from a hot list that you create, or typing in the URL of the site that you want to visit after you use the open URL command (by typing Ctrl-O or selecting Open URL... from the File menu).

The Spry stack and dialer are among the more robust that we've used, and CompuServe's version performed without a problem. During several weeks of use, our CompuServe setup behaved reliably on a Gateway P5-60 and an IBM ThinkPad 360C. The Spry browser also performed well, including properly handling home pages built with the Netscape extensions. Because these extensions aren't part of the current HTML (Hypertext Markup Language) standard, they can cause problems with the way in which some browsers display images.

The downside of CompuServe's Internet

access is its lack of integration. To browse the Web, you must call a specific phone number and use the Spry software. To peruse news groups, or to use FTP to download a file or use telnet (a remote terminal program), you must resort to a terminal emulator or one of CompuServe's custom software packages. CompuServe is working to address these issues; see the Technology Focus box at left.

### On Target with AOL

Like CompuServe, AOL was still beta-testing its Web software during our review period. However, unlike CompuServe's software, AOL's is nicely integrated into the regular AOL package, as are the clients for FTP, news groups, and gopher (a database search engine).

You will need special software to browse the Web from AOL. The current distribution disk is version 2.0. You must load this version of the software to get AOL in the first place. To use the Web browser, you need the version 2.5 preview edition, available for downloading from AOL.

If you're working from a LAN that is linked to

a T1 connection to the Internet,

you'll find a pleasant surprise: One of the setup items in the network-selection pull-down menu is TCP/IP. It worked for us with no fuss on NetWare networks. We were able to connect virtually instantly and run AOL at T1 speeds. AOL is rapidly adding 28.8-Kbps connections for high-speed modem access, but so far they are concentrated in major metropolitan areas.

The browser itself looks a bit different from most of its competitors; it's much more boxy and industrial looking. The usual menu bar and collection of buttons span the top of the screen, but the buttons are long, horizontal rectangles instead of the more common squarish ones (see the screen on page 229).

Walking the Web with AOL is a breeze. You simply click on hot-linked icons or text links to jump to another page, or you type in a URL just as you would with any

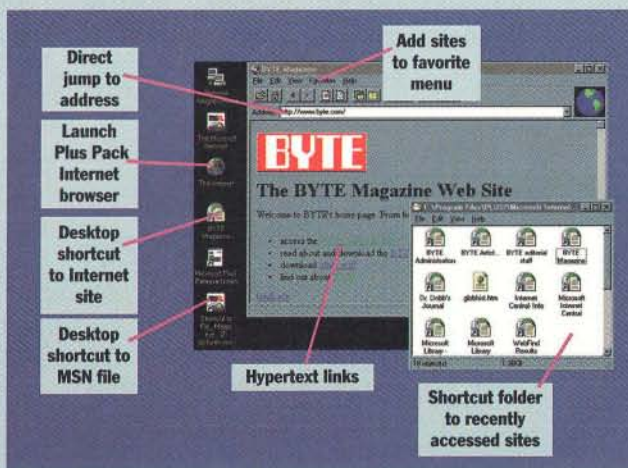


# MSN: Desktop Internet

With a vision of extending the Windows 95 desktop out to the world, Microsoft is busy building seamless World Wide Web access for the Microsoft Network, or MSN. Microsoft licensed the NCSA (National Center for Supercomputing Applications) Mosaic Web Browser from Spy International and, more significant, bought minority interest in UUNet, the world's largest ISP (Internet service provider).

Microsoft is now extending both, enhancing Mosaic to support the Windows desktop (e.g., drag and drop, right mouse-clicks, and so on) and branching UUNet into more sites worldwide. Currently, the Internet access points are limited—we had to call in to New York from New Hampshire—but Microsoft intends to open many additional lines shortly.

The enhanced browser, a component of the Microsoft Plus Windows 95 Companion Pack, accesses the Web through your own service provider, across the LAN (if you have a



LAN-based connection), or via MSN. The Plus Pack sticks an Internet icon on the Windows 95 desktop.

You click on this icon to launch the browser, starting off in a Microsoft Web page that serves as an opening menu. From there, you can take a tutorial, go surfing on your own, or search for specific subjects using the Lycos Internet catalog. Once you're out of Microsoft's page, you're navigating the Web just as you would expect, jumping across various sites by clicking on hyperlinks

or hopping directly to specific addresses.

From the menu bar, you can create a desktop shortcut to any site, build a list of favorite sites, or pull up a history window of recently accessed pages. You can drag and drop text or images to the desktop or to other applications. To capture an image to disk, you simply point at the image, click the right mouse button, and select Save As.

Where to Find

**Microsoft Corp.**  
Redmond, WA  
(206) 882-8080  
fax: (206) 936-7329  
www.microsoft.com

browser on a standard ISP. Using other Internet clients is just as easy. They are well integrated, also appearing as launchable icons. A news-group reader, a gopher/WAIS (Wide Area Information Service) client, and an FTP client are available.

## Prodigy Plows Ahead

Prodigy, after a long, uphill battle against skepticism, has gained an edge on its competition. Its Internet access is easily the best integrated of the three services.

To be sure, most of Prodigy still looks like—well, Prodigy. Its screens have a decided look of NAPLPS (North American Presentation-Level Protocol Syntax), an older standard that features big characters,

crude graphics, and generally an old-days-in-cyberspace appearance. However, its Web browser propels Prodigy into the mid-1990s. With its high-resolution display of non-Prodigy pages, it provides a sharp contrast to the rest of Prodigy.

The browser itself is efficiently laid out: It has the usual menu bar at the very top, and buttons and URL boxes under the bar, with an activity indicator next to them. There's no special installation needed for the browser because it's part of the normal Prodigy installation.

Prodigy's browser is easy and intuitive to use. Just click on what you want, and you're there. How fast you get there is limited by the connection speed of your modem—in Prodigy's case, it's 14.4 Kbps, although 10 major cities were expected to get 22.8 Kbps by late July. That's better than 9600 bps, but it can lead to slow transfer times when you're dealing with graphics-intensive home pages. The Prodigy home page itself is skillfully designed to load fast: It has a modest-size graphic at the top and then, like the Com-

puServe home page, drops into a heavily text-oriented page.

## Do We Have a Winner?

For general prowling around the Internet, we'd select AOL because of its good integration and high-speed modem (and T1) connections. Prodigy would run a close second, falling somewhat short because of its slower modem links and lack of a T1 connection. CompuServe brings up the rear. Without the upcoming improvements in WinCim, it's simply too much work having to switch back and forth from the main system to the Web browser.

The wild card is Microsoft Network, or MSN, Microsoft's fledgling network (see the text box "MSN: Desktop Internet" above). Built with Internet integration in mind, it should compete as an Internet gateway right out of the starting block. ■

*George Bond is publisher of Sams.net, the Internet imprint of Macmillan Computer Publishing USA, and publisher of such titles as Teach Yourself Web Publishing with HTML in a Week and Internet Unleashed. In an earlier life, he cofounded BIX. You can contact him on the Internet at gbond@sams.mcp.com or on BIX as "gbond."*

**America Online** . . . \$9.95  
(monthly fees, excluding hourly charges)  
American Online, Inc.  
Vienna, VA  
(800) 827-6364  
(703) 448-8700  
Circle 1033 on Inquiry Card.

(614) 529-1349  
fax: (614) 529-1610  
sales@cis.compuserve.com  
Circle 1034 on Inquiry Card.

**Prodigy** . . . \$9.95  
(monthly fees, excluding hourly charges)  
Prodigy Services Co.  
White Plains, NY  
(800) 776-3449  
(914) 448-8000  
info99a@prodigy.com  
Circle 1035 on Inquiry Card.

**CompuServe** . . . \$9.95  
(monthly fees, excluding hourly charges)  
CompuServe, Inc.  
Columbus, OH  
(800) 848-8199



From the Editors of BYTE Magazine . . .

Available  
NOW!

# BYTE on CD-ROM

FIVE YEARS OF BYTE AT YOUR FINGERTIPS!

- Cover Stories • Product Reviews • BYTE Lab/NSTL Reports
- Benchmarks • Features • Core Technologies Columns
- Product and Technology News
- And Much More!

Introductory  
Offer:  
**SAVE \$5**  
off the regular  
price!



Place Your Order  
Today!  
Call 1-800-924-6621  
or FAX your order  
609-426-5592

**SEARCH**  
for product,  
technology,  
company, author

**SELECT**  
copy and print  
what you need!

**LOCATE**  
the information you  
need quickly and  
easily from your  
BYTE issues library

**EXPORT**  
selected articles  
to your word  
processor

**FIND**  
search results in  
context, by issue,  
or by article title

**SCAN**  
the comprehensive  
index in as much  
detail as you need

#### Order Now & Save!

Order BYTE on CD-ROM today for only \$54.95 and receive the full text of BYTE from 1990-1994 PLUS quarterly updates on CD-ROM that include full text and graphics from every issue in 1995! Or order the full text of BYTE on CD-ROM (text only) from 1990-1994 for only \$39.95.

☐ Send me **BYTE on CD-ROM PLUS** 1995 quarterly updates with full text and graphics for just \$54.95.

☐ Send me **BYTE on CD-ROM** with the full text of BYTE from 1990-1994 for just \$39.95.

Charge my: ☐ MasterCard ☐ Visa ☐ Amex ☐ Check enclosed (make checks payable to BYTE Magazine, US Funds O

Card # \_\_\_\_\_ Exp. Date \_\_\_\_\_ Signature \_\_\_\_\_

Name \_\_\_\_\_ Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Mail to: **BYTE on CD-ROM**  
PO Box 526, Hightstown, NJ 08520

Circle 63 on Inquiry Card.

CDBY653

Canadian and US orders, please add \$2.95 for shipping and handling, and state sales tax where applicable (Canadian orders add appropriate GST). Outside North America, add \$5.00 for air mail delivery. Allow 6-8 weeks for delivery.

# BYTE

1-800-924-6621 Credit card orders only  
Because the *Experts* decide.



# Presentation Quality

**Snap-on, snap-off: IBM's slick new screen technology turns the ThinkPad 755CV into a remote-control color presentation panel**

EDMUND X. DEJESUS

**Y**ou've never seen anything like IBM's ThinkPad 755CV notebook computer—guaranteed. A superb blend of at least three interesting technologies, the base machine includes a 100-MHz 486DX4 processor (upgradable to a Pentium); a 10.4-inch, 65,536-color active-matrix display; a TrackPoint III pointer; and PC Card, or PCMCIA, slots for one Type III or two Type I or II cards. The ThinkPad 755CDV, a 755CV with an integrated CD-ROM drive, was released in June.

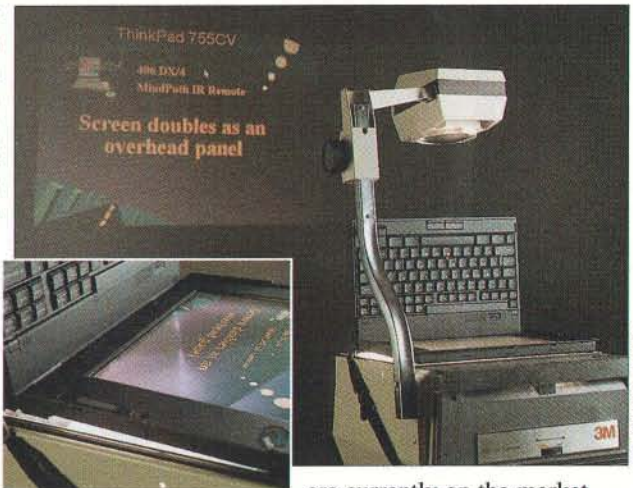
That's pretty good for starters. But in addition to all that, when you undo a latch on either side of the screen, the reinforced casing lifts off the back of the screen, transforming the now-transparent screen into a presentation panel that opens flat for simple attachment onto any standard overhead projector.

Thus, your presentation can be show-and-tell, with the integrated Mwave DSP (digital signal processor) chip delivering audio narration, music clips, and sound effects. This DSP chip also supports recording and playback, MIDI and Sound Blaster support, and a full-duplex speakerphone in conjunction with the internal 14.4-Kbps fax modem.

And, to enable you to magically control your presentation from across the room, front and rear infrared ports accept commands from the wireless MindPath Technologies infrared remote control. MindPath's Presentation F/X software lets you control mouse-cursor movements, click and double-click, and invoke any of over 20 special effects. The infrared ports also allow the exchange of data with IRDA-standard (Infrared Device Association) printers and other computers at rates as high as 115.2 Kbps.

## The Competition

There are other presentation panels that offer remote control; there are even other notebooks that can turn into presentation panels, including Aquiline's Cruiser, Boxlight's Multi-book, IntelliView's DPS-1 and DPS-3, and Revered Technology's Power Cruiser. But there's nothing else that offers the flexibility and gee-whiz appeal of the 755CV. And, for approximately the same price that you would pay for the LCD color active-matrix projection panels that



LARRY DUNN © 1995

## Double Your Pleasure

Ted Selker got tired of hearing people say that it couldn't be done. So, to prove a point, the IBM research scientist performed surgery on the back of a ThinkPad that he bought at retail. That was the prototype of the 755CV's presentation panel.

Color active-matrix TFT (thin-film transistor) LCD screens are difficult enough. Between the protective surfaces are polarizing filters and one plane of liquid-crystal gel for each of three colors (red, green, and blue); each plane is coated with transistors that control each pixel. When a tiny transistor is turned on, the liquid crystal at that point twists, losing transparency.

In the 755CV's design, the LCD display is held in a rigid die-cast aluminum frame whose top holds a CCFT (cold cathode fluorescent tube) light source, a backing reflective Mylar foil, and the power supply for the light. When the back casing is in place, a switch in the display base activates the light source. This interlock prevents safety risks while the back is off.

The 755CV's screen opens flat (see the inset above). Special straps attached to the notebook fasten the entire machine onto an overhead projector, with the screen suspended about 2 inches above the projector's surface. This space dissipates the heat from the projector. The final result is a marvel of engineering—and a practical product to boot.

are currently on the market (\$4000 to \$12,000), you can purchase a projection panel and a full-featured ThinkPad in one box.

The Class B 755CV weighs 6.6 pounds with battery pack, and you can swap out the front-mounted 3½-inch floppy drive for another PC Card slot or a wireless modem. On BYTE's Thumper 2 battery-life test, the Energy Star-approved 755CV scored 3 hours, 38 minutes, which is in line with the claimed 3.3 to 10 hours (4.1 to 12 hours with the optional lithium-ion battery).

Two minor complaints are that the system has no handle, and setup for the infrared remote control is not intuitive. But if you're weary of making and carrying overhead foils—or if you just want to impress other technophiles—you'll find your machine in the 755CV. ■

*Edmund X. DeJesus is a BYTE senior editor. He has a Ph.D. in physics and has been a professional programmer for over 15 years. You can reach him on the Internet or BIX at edejesus@bix.com.*

## Product Information

ThinkPad 755CV ..... \$6099  
ThinkPad 755CDV ..... \$7099  
(includes integrated CD-ROM drive)

## IBM Corp.

Armonk, NY  
(914) 765-1900  
(800) 426-2968

Circle 1032 on Inquiry Card.



only when a  
ng a resistance  
work done w  
gives an ans  
machine the w  
— and th  
— dist  
f. ic

three  
motion

dis  
the operator  
the  
least

**TO TECHNOLOGY  
THAN JUST  
Y'S CHANGED**

III  
6000

II  
150#  
3  
9  
3.2

I  
R  
Δ  
E = 1 = R  
E

IV  
2000

V  
2000

VI  
2000

VII  
2000

VIII  
2000

IX  
2000

X  
2000

XI  
2000

XII  
2000

XIII  
2000

XIV  
2000

XV  
2000

XVI  
2000

XVII  
2000

XVIII  
2000

XIX  
2000

XX  
2000

XXI  
2000

XXII  
2000

XXIII  
2000

XXIV  
2000

XXV  
2000

XXVI  
2000

XXVII  
2000

XXVIII  
2000

XXIX  
2000

XXX  
2000

XXXI  
2000

XXXII  
2000

XXXIII  
2000

XXXIV  
2000

XXXV  
2000

XXXVI  
2000

XXXVII  
2000

XXXVIII  
2000

XXXIX  
2000

XL  
2000

XL I  
2000

XL II  
2000

XL III  
2000

XL IV  
2000

XL V  
2000

XL VI  
2000

XL VII  
2000

XL VIII  
2000

XL IX  
2000

XL X  
2000

XL XI  
2000

XL XII  
2000

XL XIII  
2000

XL XIV  
2000

XL XV  
2000

XL XVI  
2000

XL XVII  
2000

XL XVIII  
2000

XL XIX  
2000

XL XX  
2000

XL XXI  
2000

XL XXII  
2000

XL XXIII  
2000

XL XXIV  
2000

XL XXV  
2000

XL XXVI  
2000

XL XXVII  
2000

XL XXVIII  
2000

XL XXIX  
2000

XL XXX  
2000

XL XXXI  
2000

XL XXXII  
2000

XL XXXIII  
2000

XL XXXIV  
2000

XL XXXV  
2000

XL XXXVI  
2000

XL XXXVII  
2000

XL XXXVIII  
2000

XL XXXIX  
2000

XL XL  
2000

XL XL I  
2000

XL XL II  
2000

XL XL III  
2000

XL XL IV  
2000

XL XL V  
2000

XL XL VI  
2000

XL XL VII  
2000

XL XL VIII  
2000

XL XL IX  
2000

XL XL X  
2000

XL XL XI  
2000

XL XL XII  
2000

XL XL XIII  
2000

XL XL XIV  
2000

XL XL XV  
2000

XL XL XVI  
2000

XL XL XVII  
2000

XL XL XVIII  
2000

XL XL XIX  
2000

XL XL XX  
2000

XL XL XXI  
2000

XL XL XXII  
2000

XL XL XXIII  
2000

XL XL XXIV  
2000

XL XL XXV  
2000

XL XL XXVI  
2000

XL XL XXVII  
2000

XL XL XXVIII  
2000

XL XL XXIX  
2000

XL XL XXX  
2000

XL XL XXXI  
2000

XL XL XXXII  
2000

XL XL XXXIII  
2000

XL XL XXXIV  
2000

XL XL XXXV  
2000

XL XL XXXVI  
2000

XL XL XXXVII  
2000

XL XL XXXVIII  
2000

XL XL XXXIX  
2000

XL XL XL  
2000

XL XL XL I  
2000

XL XL XL II  
2000

XL XL XL III  
2000

XL XL XL IV  
2000

XL XL XL V  
2000

XL XL XL VI  
2000

XL XL XL VII  
2000

XL XL XL VIII  
2000

XL XL XL IX  
2000

XL XL XL X  
2000

XL XL XL XI  
2000

XL XL XL XII  
2000

XL XL XL XIII  
2000

XL XL XL XIV  
2000

XL XL XL XV  
2000

XL XL XL XVI  
2000

XL XL XL XVII  
2000

XL XL XL XVIII  
2000

XL XL XL XIX  
2000

XL XL XL XX  
2000

XL XL XL XXI  
2000

XL XL XL XXII  
2000

XL XL XL XXIII  
2000

XL XL XL XXIV  
2000

XL XL XL XXV  
2000

XL XL XL XXVI  
2000

XL XL XL XXVII  
2000

XL XL XL XXVIII  
2000

XL XL XL XXIX  
2000

XL XL XL XXX  
2000

XL XL XL XXXI  
2000

XL XL XL XXXII  
2000

XL XL XL XXXIII  
2000

XL XL XL XXXIV  
2000

XL XL XL XXXV  
2000

XL XL XL XXXVI  
2000

XL XL XL XXXVII  
2000

XL XL XL XXXVIII  
2000

XL XL XL XXXIX  
2000

XL XL XL XL  
2000

XL XL XL XL I  
2000

XL XL XL XL II  
2000

XL XL XL XL III  
2000

XL XL XL XL IV  
2000

XL XL XL XL V  
2000

XL XL XL XL VI  
2000

XL XL XL XL VII  
2000

XL XL XL XL VIII  
2000

XL XL XL XL IX  
2000

XL XL XL XL X  
2000

XL XL XL XL XI  
2000

XL XL XL XL XII  
2000

XL XL XL XL XIII  
2000

XL XL XL XL XIV  
2000

XL XL XL XL XV  
2000

XL XL XL XL XVI  
2000

XL XL XL XL XVII  
2000

XL XL XL XL XVIII  
2000

XL XL XL XL XIX  
2000

XL XL XL XL XX  
2000

XL XL XL XL XXI  
2000

XL XL XL XL XXII  
2000

XL XL XL XL XXIII  
2000

XL XL XL XL XXIV  
2000

XL XL XL XL XXV  
2000

XL XL XL XL XXVI  
2000

XL XL XL XL XXVII  
2000

XL XL XL XL XXVIII  
2000

XL XL XL XL XXIX  
2000

XL XL XL XL XXX  
2000

XL XL XL XL XXXI  
2000

XL XL XL XL XXXII  
2000

XL XL XL XL XXXIII  
2000

XL XL XL XL XXXIV  
2000

XL XL XL XL XXXV  
2000

XL XL XL XL XXXVI  
2000

XL XL XL XL XXXVII  
2000

XL XL XL XL XXXVIII  
2000

XL XL XL XL XXXIX  
2000

XL XL XL XL XL  
2000

XL XL XL XL XL I  
2000

XL XL XL XL XL II  
2000

XL XL XL XL XL III  
2000

XL XL XL XL XL IV  
2000

XL XL XL XL XL V  
2000

XL XL XL XL XL VI  
2000

XL XL XL XL XL VII  
2000

XL XL XL XL XL VIII  
2000

XL XL XL XL XL IX  
2000

XL XL XL XL XL X  
2000

XL XL XL XL XL XI  
2000

XL XL XL XL XL XII  
2000

XL XL XL XL XL XIII  
2000

XL XL XL XL XL XIV  
2000

XL XL XL XL XL XV  
2000

XL XL XL XL XL XVI  
2000

XL XL XL XL XL XVII  
2000

XL XL XL XL XL XVIII  
2000

XL XL XL XL XL XIX  
2000

XL XL XL XL XL XX  
2000

XL XL XL XL XL XXI  
2000

XL XL XL XL XL XXII  
2000

XL XL XL XL XL XXIII  
2000

XL XL XL XL XL XXIV  
2000

XL XL XL XL XL XXV  
2000

XL XL XL XL XL XXVI  
2000

XL XL XL XL XL XXVII  
2000

XL XL XL XL XL XXVIII  
2000

XL XL XL XL XL XXIX  
2000

XL XL XL XL XL XXX  
2000

XL XL XL XL XL XXXI  
2000

XL XL XL XL XL XXXII  
2000

XL XL XL XL XL XXXIII  
2000

XL XL XL XL XL XXXIV  
2000

XL XL XL XL XL XXXV  
2000

XL XL XL XL XL XXXVI  
2000

XL XL XL XL XL XXXVII  
2000

XL XL XL XL XL XXXVIII  
2000

XL XL XL XL XL XXXIX  
2000

XL XL XL XL XL XL  
2000

XL XL XL XL XL XL I  
2000

XL XL XL XL XL XL II  
2000

XL XL XL XL XL XL III  
2000

XL XL XL XL XL XL IV  
2000

XL XL XL XL XL XL V  
2000

In today's business environment, technology is changing so fast even your most talented people are hard-pressed to keep pace. Downsizing has got everyone busy doing two jobs—when they're not doing three. And the only thing tighter than time these days is your travel budget.

## Benefit from customized training programs

With Datapro's On-Site Training you can tailor your high-tech curriculum to suit your company's specific needs. Our skilled instructors will develop an individualized training program including state-of-the-art teaching aids and hands-on instruction. The bottom line: Datapro's custom curriculum means you never have to pay for information your employees already know or won't really use.

**CUSTOMIZE YOUR TRAINING CURRICULUM FROM THESE COMPREHENSIVE COURSES**

- Advanced PC Troubleshooting

It's easy to understand why leading companies have been taking advantage of Datapro's On-Site Training for more than 23 years—among them AT&T, CODEX, EDS, IBM, McDonnell-Douglas, MCI, Prime Computer, Unisys, and US West. There's no better way to get the most from your training budget.

**For more information on Datapro's convenient, on-site training call Judi Rustin at 1-800-328-2776, ext. 2896 or 2857.**

- Advanced PC Troubleshooting
- Client/Server Computing
- Computer Telephony Integration (CTI)
- Database Tools
- The Internet
- Object-Oriented Programming
- PC-LAN and Data Security
- Platform Development Skills
- System Engineering
- Unix Fundamentals
- Visual BASIC



A Division of The McGraw-Hill Companies

McGraw-Hill House  
Shoppenhangers Road  
Maidenhead, Berkshire,  
England SL6 2QL  
Tel.: +44 1 628 773277  
Fax: +44 1 628 773628

20 Cecil Street  
21-07 The Exchange  
Singapore 0104  
Tel.: +65 5384432  
Fax: +65 5384436



# Networking at Warp Speed

**Easy LAN installation and peer services make IBM's OS/2 Warp Connect a serious network contender**

**BARRY NANCE**

**T**o stem the tide of Windows 95, IBM has sweetened the OS/2 pot. IBM reasons that if OS/2's technical strengths don't overwhelm you, the boatload of networking and application software in the Warp Connect upgrade will be more persuasive.

OS/2 Warp Connect bundles LAN requesters, peer-to-peer networking, groupware and E-mail, Internet access, a full-featured word processor, a spreadsheet, a personal information manager, a fax utility, remote access, communications programs, and other goodies. Curiously missing from Warp Connect is an NFS client for connecting to Unix servers; you have to buy NFS separately.

The new Warp is robust, reliable, and responsive. That's not surprising, since the underlying OS/2 technology has had years to mature.

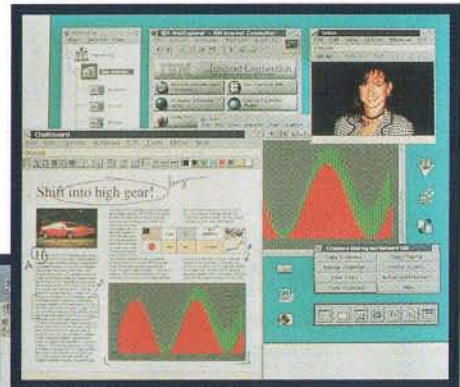
Warp Connect (\$299) costs significantly more than the \$89 basic Warp product, and it requires roughly twice as much disk space and RAM.

Warp Connect takes from 25 to 90 MB of disk space and at least 12 MB of RAM, depending on which features you install. IBM recommends at least 8 MB, but we found performance is much better with 12 MB.

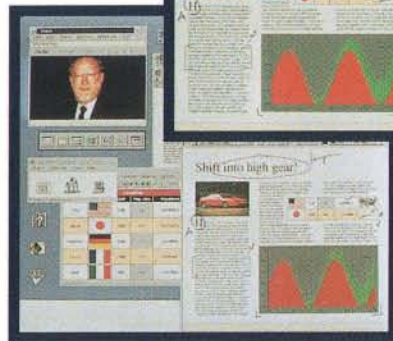
Almost all of Warp Connect's features,

including the requesters, LAN Distance, CID (Configuration, Installation, and Distribution), and the Bonus Pack of applications, have been around for a while; Warp Connect brings them together in one box. However, the peer-to-peer networking is new, as is the installation program for network options.

We installed Warp Connect on a dozen PCs (mostly 486s and Pentiums). The peer-to-peer networking services worked well and offered better security and reliability than Windows for Workgroups. The peer networking and LAN Server requester features let Warp Connect access files, printers, and CD-ROM drives on computers running Warp Connect itself; IBM's LAN Server and PC LAN Program; Microsoft's Windows for Workgroups, Windows NT, and LAN Manager; and Artisoft's LANtastic. Warp Connect peers and LAN Server clients can even use the same modems via shared serial port access to PCs running OS/2-based communications software. These Peer Services are, in fact, a superset of the LAN Requester in all ways except one: To run the LAN Server graph-



**IBM's Person to Person software can now be run with Warp's new Peer Services to provide peer-to-peer videoconferencing.**



ical administration tools, you must use the LAN Requester instead of Peer Services.

When we added the NetWare Requester, the resulting dual-protocol stack consumed extra extended memory, but it still left nearly 640 KB of conventional memory for each DOS and Windows session. Trying to use multiple protocols in a DOS or a DOS-plus-Windows machine, however, left us with insufficient memory to run applications. The only problem the NetWare Requester exhibited was slow access to NetWare drives assigned through the Network folder. Drive mappings that were established through the NetWare Tools utility behaved normally.

For smaller networks (typically 10 or fewer PCs), or for a decentralized campus environment, Warp Connect's Peer Services are useful and productive. Beyond eight or 10 clients, you'll need a separate file server running a product such as NetWare or LAN Server.

The networking utilities in OS/2 Warp Connect include Network SignOn Coordinator, a help database, and LAN Distance Remote. Network SignOn holds logon names and passwords and sends them out to the various services. The help database lets you perform keyword searches for frequently asked questions, setup guides, and descriptions of known problems. LAN Distance Remote is a client for a LAN Distance Server that lets your PC

## The Networking Difference

Warp Connect augments basic OS/2 Warp with IBM and third-party network client technologies such as NetWare Requester 2.11, LAN Server 4.0 Requester, OS/2 Peer to Peer, LAN Distance Remote 1.1, Lotus Notes Express (an entry-level Notes client), and support for TCP/IP, IPX, and NetBIOS/NetBEUI. There's also a comprehensive TCP/IP LAN and SLIP/PPP dial-up client that can replace the Bonus Pack's TCP/IP client. IBM TCP/IP version 3, which can maintain a dial-up Internet connection and a network card connection at the same time, includes FTP and Telnet server software. Curiously missing from Warp Connect is an NFS client for connecting to Unix servers; you have to buy NFS separately.

IBM says it will ship a Warp Connect Extend Pack later this year that will add features designed specifically to appeal to larger enterprises, such as Communications Manager/2 desktop-to-mainframe software and IBM's multiprotocol connectivity software, AnyNet/2. IBM also says it's collaborating with Novell to produce a 32-bit NetWare Requester for OS/2.



use a modem to access server files, just as if your modem were a LAN adapter.

Warp Connect's Peer Services also deliver auditing, logging, and an interface to REXX, the OS/2 scripting language. You can monitor access to shared peer resources and write REXX scripts to automate routine tasks. The Network Clipboard/DDE lets you cut and paste clipboard data across the LAN or—if you use NetBIOS over TCP/IP—across the Internet. Peer Services also includes an OS/2 program for playing chess across a network. And the Person to Person application lets you do workgroup and videoconferencing (see the screen on page 235).

## The Installation Ceremony

IBM has really improved OS/2's much-criticized installation procedure. The system's tool for detecting LAN adapters (see "Sniffing Out LAN Hardware" at right) correctly identified most network cards we tested, failing only with the difficult-to-identify Eagle NE2000 card: An NE2000 adapter (or clone) doesn't offer software a clear-cut ROM address or I/O port signature for identification purposes. The installation program easily recognized (and configured Warp for) cards from such manufacturers as Thomas-Conrad, Madge, IBM, Intel, and SMC.

You are offered three ways to install Warp Connect: easy, tailored, and hands-off. The hands-off installation method (called CID) is appropriate for large organizations that want to seed Warp onto many LAN-connected PCs quickly and painlessly. CID is an IBM-designed, over-the-wire software distribution mechanism that creates a redirected installation environment.

To quickly install a CID-enabled product such as Warp Connect across a LAN, you modify a template script supplied with Warp Connect and run the LAN CID utility. A component called the Service Installable File System (SRVIFS) handles file redirection between the code server and the client workstation. We found the CID scripts easy to set up and run.

A server-based LAN CID REXX program identifies the products that you want to install. Individual product-response files contain the menu selections and choices of features that you otherwise would have to provide interactively. A SRVIFS configuration file sets up the code server. The bottom line is that you can install Warp Connect (or an-

## Sniffing Out LAN Hardware

When you want to know what kind of LAN adapter your computer uses, you remove the cover and inspect the adapter. But installation software that wants to identify your LAN adapter has to use machine instructions to detect and identify such hardware. Micro Channel and EISA adapters are relatively easy to detect; both architectures supply configuration data to programs. ISA-based PCs, on the other hand, present installation software with a minefield of problems.

Warp Connect's installation program invokes functions within a DLL to sniff out LAN hardware. This DLL contains code that identifies 250 to 300 different network adapters; two-thirds of this code is for ISA adapters. IBM programmers regularly add new entries to the list. Each addition goes through regression tests to make sure the new code doesn't crash in the presence of the other listed adapters.

The DLL steps carefully through a series of adapter-signature tests to find out what LAN adapter you have. The tests first look through adapter ROM for patterns of bytes. Sometimes the software uses adapter-specific sequences of IN and OUT machine instructions to make the query. Because the same adapter can often use different I/O addresses and IRQs, the detection software often must make several attempts at identifying it.

The order of the tests is important. The same sequence of IN/OUT instructions that detects one kind of adapter might cause a different kind to freeze the computer. And the possibility of troublesome interactions between the detection software and adapters sensitive to certain machine instructions makes it important to figure out which adapters are examined first.

To run the detection code outside the installation procedure, open a Warp Connect OS/2 command-line session and run the OS2SNIFF program in the GRPWARE directory. OS2SNIFF will invoke the detection routines in NCD.DLL and display the results on-screen.



The installation program sniffs out network adapters, then gives you confirmation of those that are installed.

other CID-enabled product) on about 300 PCs in a single day.

## Wrapping It Up

We can't go without faulting the single input message queue, which makes it possible for one badly behaved Presentation Manager application to prevent other applications from receiving event-queue messages. Also, Warp Connect needs an intelligent maintenance utility for CONFIG.SYS statements, especially since network software can increase the number of

such statements to more than 100. The lack of an NFS client is a glaring omission. And the installation program gets confused if there's more than one LAN adapter in your

PC (though you can fix such problems by editing the CONFIG.SYS, NET.CFG, and PROTOCOL.INI files by hand).

Overall, though, OS/2 Warp Connect has a lot to offer. The combination of in-the-box networking with a mature 32-bit operating system that runs Windows, Win32s, DOS, and OS/2 software makes this a productive, useful environment. Warp Connect offers all the essential features of both Windows 95 and Windows NT while adding features (such as the Bonus Pack and Notes Express) that the competition lacks. ■

Contributing editor Barry Nance has been a programmer for 25 years. He is the author of *Using OS/2 Warp 3.0*, *Introduction to Networking*, and *Client/Server LAN Programming*. You can reach him via the Internet at [barryn@bix.com](mailto:barryn@bix.com).

Product Information

**OS/2 Warp Connect 3.0** . . . \$299  
(CD-ROM only; includes Windows)  
IBM  
Armonk, NY 10504  
(800) 342-6672  
(914) 765-1900  
fax: (313) 225-4020  
**Circle 1144 on Inquiry Card.**



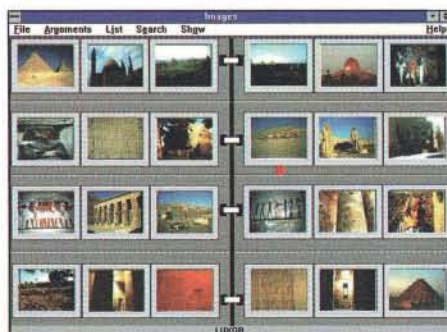
**Don't just settle for collections of pictures!**

# TRAVEL NOTES ON CD

TRAVEL NOTES ON CD is an ambitious project, the result of intensive research work, which will take you on a voyage of rediscovery of our planet, nature and the peoples who formed it over the centuries.

TRAVEL NOTES ON CD is an extensive library, with more than 100 exclusive photographs by well known photographers on each CD-ROM, presented by means of a sophisticated WINDOWS PROGRAM which permits personalized selection of the pictures.

It is also possible to active a "SLIDE" function which guides us on our personalized journey.



**Configuration required:** Windows 3.1 or higher, CPU 386 or higher, 4 megabytes of RAM, VGA graphic card.

The pictures contained in the CD are in 640\*480 format with 16 million colours.

**Recommended:** SVGA graphic card, 1 megabyte of RAM, compatible Sound Blaster card.

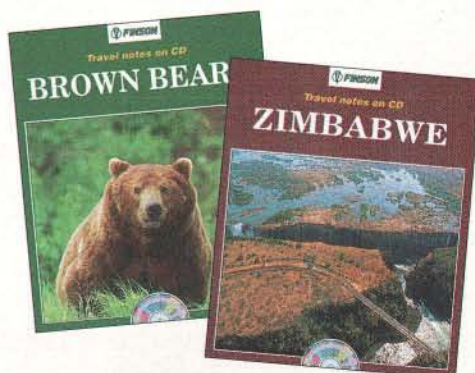
**Ask for our full catalogue!**

Already available: **ZIMBABWE, POLAR BEARS, BROWN BEARS, SOUTH AFRICA, EGYPT, AFRICAN FELINES, GREAT AFRICAN HERBIVORES, ANIMALS OF INDIA, NAMIBIA, MALAWI, FRENCH POLYNESIA, NEW ZELAND, GREATER ANTILLES, ORCHIDS.**

Coming out soon: **PARKS OF AFRICA, MAURITANIA AND SENEGAL, KENYA, ZAIRE, TANZANIA, MOROCCO, DOGS, CATS.**



**THE BEST  
VALUE FOR  
MONEY!  
ASK FOR OUR  
PRICE LIST.**



MS-WINDOWS is a registered trademark of the Microsoft Corporation

Each photograph is accompanied by a full caption, both in writing and sound; various zoom and colour modification effects are available and the pictures can be printed and, if desired, exported to the most common formats (BMP, TIFF, PCX, JPG, GIF).

**INTERNATIONAL  
DISTRIBUTORS  
WELCOME!**



FINSON srl - Via Montepulciano, 15 - 20124 Milano (ITALY)  
Tel. +39-2-66987036 - Fax +39-2-66987027  
INTERNET: MC8468@MCLINK.IT - FINSON.SRL@AGORA.STM.IT

Circle 105 on Inquiry Card.



# BYTE

# WEARHOUSE

Celebrate BYTE's 20th Anniversary with  
Special Limited Edition Merchandise

All products are officially  
approved by BYTE.



## BASEBALL CAP

Soft brushed cotton free-form cap with adjustable Velcro closure back. Black. (BYT 11) \$10.00



## MUG

11oz. ceramic mug with logo on both sides. (BYT 8) \$4.50

## MOCK TURTLENECK

Outer Banks 100% cotton mock turtleneck. White. Sizes M(BYT 4), L(BYT 5), XL(BYT 6). \$26.00

## INSIGNIA PEN

Parker Insignia ball point pen. Lacquer black. (BYT 9) \$34.50



## VECTOR PEN

Parker Vector Sport roller ball pen. Black. (BYT 10) \$6.25



## SWEATSHIRT

11 oz. cross grain Lee sweatshirt features generous athletic cut and side gussets. 95% cotton, 5% polyester. Ash. Sizes M(BYT 1), L(BYT 2), XL(BYT 3). \$31.00



## MOUSE PAD

Hard top mouse pad. 7.5"x 8.5". (BYT 7) \$5.25

## COMPUTER TOOL KIT

Deluxe computer device tool kit in black vinyl zipper case features: 2 nut drivers, 3-prong parts retriever, torx driver, IC extractor, 1 phillips and two slotted screwdrivers. (BYT 12) \$20.00



## T-SHIRT

100% cotton Oneita Power-T. White. Sizes L(BYT 13), XL(BYT 14). \$8.00



**Call 1-800-676-4256**

or 1-708-647-4906 in Illinois, 8:30 a.m.-5:00 p.m. Central Time.  
We accept VISA, MasterCard, American Express, and Discover.

Merchandise in stock will ship within 3 days of receipt. HA-LO notifies customers of out-of-stock items and gives the option to back order, substitute, or cancel the item. Sales tax additional where applicable. UPS ground shipping on domestic orders: up to \$50 - add \$5.75, \$50 to \$100 - add \$7.75, over \$100 - add 8%. Additional shipping charges apply to international orders.



# To Print a Rainbow

**Next-generation color lasers from Apple and Tektronix set high standards for print quality, connectivity, and convenience**

**TOM THOMPSON**

**T**he first generation of sub-\$10,000 color lasers, introduced last year, suffered from complicated setup and lackluster out-of-the-box network capabilities. In short, they didn't work as advertised.

Enter Tektronix, the color printer kingpin, and Apple, creator of the desktop publishing market. Both companies know the color market well, and it shows in their latest color lasers: Apple's Color Laser 12/600 and Tektronix's Phaser 540. (The Phaser 540 Plus became available just after this review; it's a 540 with legal-size printing capability and a somewhat faster printing speed for the same \$8995 price.)

Both of these printers readily manage true 600-dpi output; are easy to set up, thanks to a monocomponent print technology that dispenses with the developer cartridges; and are platform-agnostic, coming with drivers for Macintosh, PC, and Unix systems.

## Apple's Color Laser 12/600

Big and heavy, the Apple Color Laser 12/600 occupies a 21- by 23-inch area and weighs in at 110 pounds. A 25-MHz AMD 29030 RISC processor manages the printer's smarts, and 8 MB of ROM houses an Adobe PostScript Level 2 interpreter, 39 Type 1 fonts, and code that handles AppleTalk, NetWare IPX, and TCP/IP protocol stacks. Custom ASICs manage data compression and decompression and accelerate Apple's image-enhancement software.

Because the printer receives compressed image data, it needs less RAM than most color printers—only 12 MB (which comes in the base \$6989 configuration). The board holds up to 40 MB of RAM in two industry-standard 72-pin SIMM sockets.

The controller board sports a medley of I/O ports: Ethernet (Apple AUI [attachment unit interface] connector), LocalTalk, and IEEE P1284 bidirectional parallel, plus an HDI-30 SCSI port for adding font-caching hard drives. The controller scans all ports for data and can field incoming jobs of different network protocols. The Canon HX LBP print engine generates up



Sub-\$10,000 color lasers: the Tektronix Phaser 540 (left) and the Apple Color Laser 12/600.

to 3 pages per minute for color output and up to 12 ppm for monochrome.

## Phaser 540

With a 19.5- by 27.4-inch footprint and weighing 117 pounds, the Phaser 540 is also a bruiser. It uses an AMD 29030 controller (running at 32 MHz instead of 25 MHz). The ROMs provide Adobe PostScript Level 2 with 39 Type 1 fonts and include a PCL5 (Printer Control Language) interpreter. Standard RAM is 20 MB, expandable to 52 MB. A P1284 bidirectional parallel port and a SCSI-2 port are both standard.

You can attach the \$1695 Phaser Copy-Station option to add color-copying capability. An optional Phaser Share board (\$595) provides either an Ethernet or a Token Ring network interface; both support AppleTalk, IPX, and TCP/IP (which is an extra \$295). The controller switches between network protocols and emulations automatically. The Phaser 540's KME print engine can produce 3½ ppm for color and 14 ppm for monochrome at 600 dpi.

## Blazing Colors

Setup for both printers is as easy as it gets: Basically, it takes around 15 minutes to insert the photoconductor drum/belt and the four toner cartridges. Overall, the Phaser 540 handled print jobs faster than the Color Laser 12/600 because of its faster processor. The overhead of data decompression may also slow down the Apple printer. The Color Laser 12/600 processed the BYTE color PostScript test (which measures the speed of the PostScript interpreter) in 129 seconds, while the Phaser 540 fielded it in just 59 seconds.

The Color Laser 12/600's operation was initially marred by its acute sensitivity to a bad cable on BYTE's network. The printer lost data packets and had them resent until it finally timed out. After we removed

the faulty cable, the printer operated flawlessly. However, the Phaser 540, a Hewlett-Packard LaserJet IIID, and an Apple LaserWriter Pro 630—all located within several feet of the Color Laser 12/600 and connected to the same network—experienced no network difficulties from the bad wire.

*continued*

## Product Information

**Color Laser 12/600** . . . \$6989  
Apple Computer, Inc.  
Cupertino, CA  
(800) 538-9696  
(408) 996-1010  
**Circle 1030 on Inquiry Card.**

**Phaser 540** . . . . . \$8995  
Tektronix, Inc.  
Wilsonville, OR  
(800) 835-6100  
(503) 682-7377  
**Circle 1031 on Inquiry Card.**

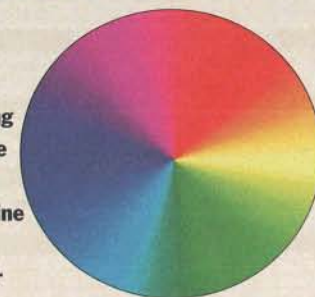


## Squeezing Colors from Pixels

Printing black text is fairly straightforward: Any given spot on the paper either has black pigment on it or does not. To get smoother edges or higher resolution, many laser printers adjust the size and even the position of the black dots on the image grid by modulating the laser beam.

Producing photographic images is more complicated because the printer must create the illusion of gray shades by tiling varied groups of black dots called *dithering patterns*. The gray shades come at the expense of resolution, but, again, laser modulation can help, either by making dithering patterns less obvious or by squeezing more gray shades from a smaller pattern. The production of dithering patterns is even more complicated with color images, because clusters of the four process colors (cyan, magenta, yellow, and black) must imitate various hues.

Both Tektronix and Apple have developed methods to effectively coerce more colors from smaller dithering patterns. By modifying the laser beam's pulse duration to give some pixels more or less energy than others, the printer's electronics affect how many ultrafine toner particles adhere to a each pixel. The result: several intensity levels for each color instead of all or none.



Laser modulation equals smoother color gradations.

Apple is aware of the problem.

Both printers handled Mac and Windows print jobs without a hitch. Plain-paper output from these printers is simply outstanding, and output with photographic images is good enough to threaten sales of dye-sublimation printers. There is little overall quality difference between the two printers, although the Apple unit appeared to do better on more types of images than the Tektronix unit did.

If you're running lots of Windows applications that speak PCL5, consider the Phaser 540. If you're dealing with PostScript, either printer is suitable. While the Phaser 540 is substantially faster, it also carries a higher price tag. An Ethernet-equipped Phaser 540 with TCP/IP support costs \$9885, while the Color Laser 12/600 comes with Ethernet standard (including TCP/IP support) for \$6989. ■

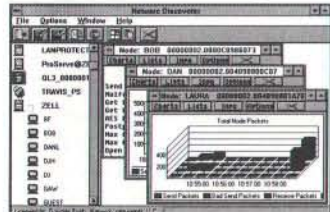
*Tom Thompson is a BYTE senior technical editor at large with a B.S.E.E. from the University of Memphis. He is an Associate Apple Developer. You can contact him on Apple-Link as "T.THOMPSON" or on the Internet or BIX at tom\_thompson@bix.com.*

# HUNT FOR UNIX TOOLS

UniDirect scouts for PC to UNIX connectivity tools!



## Troubleshooting LANs/WANs Using All Your Time?



Observer and Analyst/Probe are Microsoft Windows based LAN troubleshooting tools and protocol analyzers. With Observer or Analyst, you can view your LAN more clearly, see network traffic in real time and, with this new information, make network decisions based on facts.

**FREE Eval Copy** Observer Unlimited Network ONLY \$459!

- SAVE HOURS OF NETWORK TROUBLESHOOTING TIME
- Graphical real-time long/short term bandwidth utilization
- Statistics by station, protocol, or packet size distribution
- Auto-discover network addresses, auto-alias Novell names and TCP/IP addresses
- Packet capture decodes with pre- and post-header filtering
- Review Ethernet and Token Ring vital sign displays (broadcasts, hard/soft errors, etc.)
- Triggers & Alarms: activate message windows, captures, logs, or exec external programs
- Filter by protocol, sub-protocol, or user defined sequence offsets
- Detect duplicate IP addresses

- Chart TCP/IP network usage by telnet, ftp, NFS, and LPD/LPR
- Fully decode TCP/IP, IPX/SPX, NetBIOS, NetBEUI, NetBIOS over IP, and AppleTalk
- Use Network Discoverer to map your Network LAN and to chart and display Network trends
- Software-only MS Windows solution - no additional hardware required
- Have Ethernet and Token Ring support
- Use VxD Windows drivers for NDIS and ODI
- 20% the cost of comparable products
- ✓ Analyst/Probe for multi-segment LANs

## Low-Cost PC-to-UNIX Networking!

TinyTERM Plus from Century Software gives you complete connectivity with a variety of emulation modes. TCP/IP, LPR/LPD printer sharing, FTP file transfers, NFS option and more! Ask about our Windows 95-to-UNIX connectivity solutions!



**5 PC copy only \$279**

**1-800-613-1683**

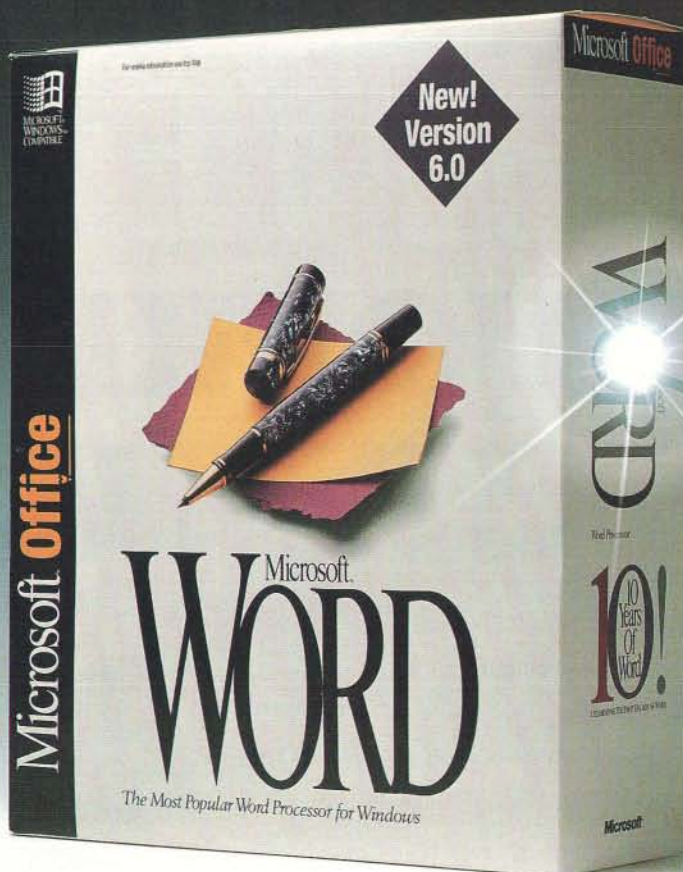
WebSite: <http://www.unidirect.com> • fax 714-707-3095 • ph 714-453-2999 • AD9002

Where the Corporate World Connects to UNIX

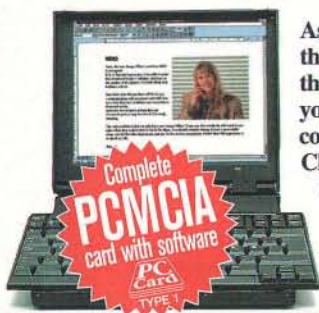
**UniDirect**







# Put pictures into Word



As you know, a picture can say more than 1000 words. Imagine then, what the Image Office™ system can do for you. It allows you to capture your own colour video images with a simple Click & Freeze! Manipulate the image or just paste it into a Microsoft® Word document or into another word processing programme. All in full colour, no compression, and high resolution.

**What you see is what you can get!**

Want to make your documents more interesting and communicate better? Long to make brilliant presentations? It's easy. Just plug in your camcorder (or any other video device), watch the video images on your PC and choose the one you want to use. Adjust the brightness, contrast and colours to suit your own personal taste. Then Click & Freeze the image into your Word document, or any other application with a resolution of 511 x 511 pixels and 24-bit true colour. It's easy, fast and powerful. Get the picture?

## A complete image system

If you have a desktop or portable PC with a PCMCIA card and access to a video source such as a VCR, camcorder, TV laser disc etc., then all you need is Image Office. The video capture system consists of a desktop digitiser card in PC Card format, a video adaptor cable, the Image Office software package and an easy-to-follow user manual. Sample images are included on the diskettes. Why use 1000 words when one single picture will do the job?



**M R T**

**MRT micro as.** Strømsvn. 74, N-2010 Strømmen, Norway  
Tel.: +47 63 89 20 20 Fax: +47 63 80 12 12  
USA Tel.: +1 603 465 2830 Fax: +1 603 465 2680  
Germany Tel.: +49 8092 880 77 Fax: +49 8092 880 76

• Australia Electro Optics Tel.: +61 2654 1873 Fax: +61 2654 1539 • Belgium Microlink Tel.: +32 2 521 8650 Fax: +32 2 521 6078 • China Beijing Da Heng Image Vision Co. Ltd. Tel.: +86 1 25 42059 Fax: +86 1 25 42058 • Denmark Tri-Star Tel.: +45 4673 3200 Fax: +45 4673 3306 • Finland Fuztech Group Oy Tel.: +358 59 432931 Fax: +358 59 432367 • France Wintech Tel.: +33 1 694 65908 Fax: +33 1 692 50371 • Germany Cameron Elektronische Tel.: +49 7117 75730 Fax: +49 7117 73336 • Greece Tecor Tel.: +30 129 25135 Fax: +30 129 15672 • Holland Computata Tel.: +31 73 440700 Fax: +31 73 440778 • Italy Elcomi Tel.: +39 2 61 95066 Fax: +39 2 61 34836 • Japan Macnica Tel.: +81 45 939 6140 Fax: +81 45 939 6141 • Portugal Bio Data Tel.: +3512 388829 Fax: +3512 3711502 • Saudi Arabia OFOQ Tel.: +966 2669 6187 Fax: +966 2669 6272 • Spain Cibal MultiMedia Tel.: +3471 713523 Fax: +3471 722600 • Sweden Amtech AB Tel.: +46 8 928065 Fax: +46 8 928077 • Switzerland MPI Tel.: +41 5683 5555 Fax: +41 5683 4860 • Taiwan O'Sted International Hi-tech Corp. Tel.: +88 62912 8633/4 88 62910 1407 Fax: +88 62 912 8632 • UK Visimetrix Tel.: +44 1436 677557 Fax: +44 1436 672131 • USA Belmont Data West Tel.: +1 415 570 7792 Fax: +1 415 570 4204. I-Cube Tel.: +1 301 464 7070 Fax: +1 301 464 0650. Ironics Tel.: +1 818 865 0005 Fax: +1 818 865 1227. Long Island Instrument Corp. Tel.: +1 516 781 4373 Fax: +1 516 781 4105. Microdisc Tel.: +1 609 486 0330 Fax: +1 609 486 7877.

Trademarks Microsoft, Windows, Word for Windows, and the Windows logo are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. All trademarks in this document are the property of their respective owners.

**Circle 116 on Inquiry Card (RESELLERS: 117).**



# BYTE <sup>ON</sup> NETWORKING

BYTE has compiled every major article written on networking from the January 1993 issue through the October 1994 issue on a multiple disk set. With easy-to-use search and retrieve capabilities, this fully indexed text database allows you to access valuable technology and product information from networking product reviews, features, news analysis, and technical columns from the pages of BYTE. All articles are

written by BYTE's staff, contributors, and other industry experts.

**ONLY  
\$14.95!**  
3-Disk Set



**AVAILABLE  
ON DISK!**

## *Here are just a few of the articles you'll find on disk:*

- ◆ Network Connections
- ◆ Fine-Tune LANTastic
- ◆ Linking LANs
- ◆ Printers Talk Back
- ◆ NetWare Goes Global
- ◆ Modems for High-Speed Communications and Portability
- ◆ Digital Remote Access
- ◆ Network Management Systems
- ◆ Enterprise Computing
- ◆ Report on Networking
- ◆ LANs Make the Switch
- ◆ Wireless Mobile Communications

**PLUS MORE!**

## Place Your Order Today!

Complete order form and send to: BYTE on Networking, Attn. Circulation Dept.,  
One Phoenix Mill Lane, Peterborough, NH 03458  
or fax to 603-924-2603

☐ Check Enclosed  
(Make checks payable to BYTE Magazine, US funds only)

☐ MasterCard    ☐ VISA    ☐ AMEX

Card # \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

Canadian and U.S. orders, please add \$2.95 for shipping and handling.  
Outside North America, add \$5.00 for air mail delivery. Please allow 6-8 weeks for delivery.  
Disk format 3 1/2 inch. Currently available for Windows only.

For telephone orders using a credit card (MasterCard, VISA, or American Express)

## CALL 1-800-924-6621

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_

Country \_\_\_\_\_ Zip \_\_\_\_\_

**BYTE**

**FOLIO.**  
INFOBASE

DK4127

Because the *Experts* decide.



# 3-D Graphics Go Zoom

Intergraph and Omnicomp offer different routes to speedy 3-D

GREG LOVERIA

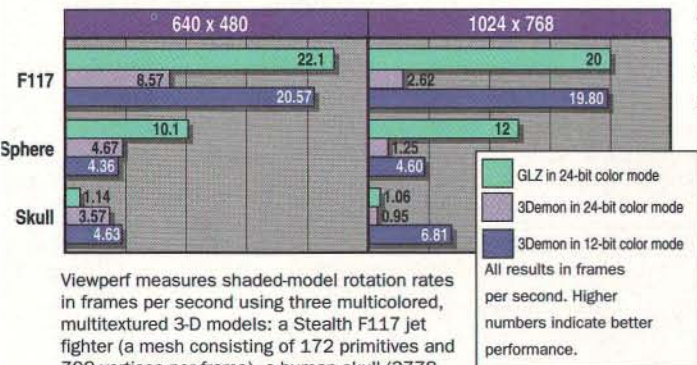
**M**ost of us would love to navigate through complex virtual 3-D scenes on our desktop PCs. But functions such as real-time 3-D animation and Gouraud shading are tough jobs for even the swiftest CPU. Most desktop PCs have enough floating-point capability for the initial geometry calculations required by 3-D modeling, but you need specialized 3-D rendering hardware to quickly turn those internal geometric representations into realistic-looking images on the 2-D surface of your monitor.

The combination of lower-cost 3-D hardware and 3-D APIs—such as Silicon Graphics' OpenGL—is making that reality more affordable. OpenGL is particularly important because it's built into Windows NT and will eventually be part of Windows 95. Cards that support OpenGL will run lots of 3-D applications.

Here we evaluate two promising approaches to 3-D acceleration: a \$2385 PCI card from Omnicomp that works with several currently popular 3-D APIs, including OpenGL; and a \$23,850 Intel-based workstation from Intergraph.

Omnicomp's 3Demon cards are the first graphics adapters to use 3DLabs' new Glint 3-D accelerator, which promises good 3-D performance at a low price. (Glint-based cards from Elsa, Fujitsu, and others should be available by now.)

## Viewperf OpenGL Results



Intergraph's new TDZ-40 system belongs to a family that delivers workstation-level 3-D performance on the Intel x86 platform. The TDZ-40 also proves that a good 3-D chip is not enough in itself for great 3-D performance (see the text box "A Whole Lotta Buffers" on page 244).

The dual-Pentium TDZ-40 is a turnkey acceleration system for MicroStation, a CAD package from Intergraph subsidiary Bentley Systems. It uses Intergraph's two-card GLZ2, an OpenGL accelerator that works in conjunction with Intergraph's MOGLE (MicroStation OpenGL Extensions) 3-D API. Omnicomp's 3Demon adapters, while aimed at improving speeds of existing 3-D and CAD applications using various 3-D APIs, can also accelerate MicroStation performance speeds using MOGLE.

## 3-D Demon

Omnicomp's 3Demon adapters all use the Glint 300SX 3-D graphics chip. Board models in the 3Demon series range from the \$1995 SX44 (4 MB each of VRAM and DRAM) to the \$3535 SX816 (8 MB of

VRAM, 16 MB of DRAM). We tested a \$2385 SX48, which has 4 MB of VRAM and 8 MB of DRAM. (Omnicomp plans an October release for its 3Demon

TX series, which uses the new Glint 400TX processor to accelerate texture mapping.) The SX44 and SX48 use the 64-bit IBM525 RAMDAC for color conversions, while the SX816 has a wider 128-bit IBM528 RAMDAC. The three-quarter-size



Intergraph's Pentium-powered TDZ-40 system combines workstation-level 3-D performance with Intel x86 software compatibility. The Omnicomp 3Demon SX48 board (perched atop the monitor) provides good 3-D performance for tighter budgets.

3Demon cards use DRAM for 32-bit Z-buffering.

Jumperless and self-configuring, the SX48 installs easily alongside any existing VGA card, which is required for boot-up purposes. The SX48 supports display resolutions of 640 by 480 pixels with 24-bit color up to 1280 by 1024 pixels with 8-bit color. It also supports 24-bit-color, double-buffered, 3-D model acceleration at display resolutions of 640 by 480 pixels up to 800 by 600 pixels.

## GLZ Sizzler

Available only in its TDZ line of workstations, Intergraph's PCI-based GLZ series of OpenGL graphics accelerators supports 24-bit color depth *only*. The GLZ1 adapter, which has 12 MB of VRAM, supports resolutions as high as 1152 by 864 pixels. The two-slot GLZ2 tested here supports resolutions of up to 1600 by 1280 pixels; it has 24 MB of onboard VRAM. Housed in an external cabinet, and packed with 34 MB of VRAM and 32 MB of DRAM, the truly scary GLZ6 supports real-time, fully texture-mapped, photo-realistic model walk-throughs. Other 3-D accelerators in this series include the GLZ3 through GLZ6. All GLZ boards are fully

LARRY DUNN © 1995



**TDZ-40** .....\$23,850  
(with two 100-MHz Pentiums, 64 MB of RAM, 2-GB hard drive, 21-inch monitor)  
Intergraph Computer Systems  
Huntsville, AL  
(800) 763-0242  
(205) 730-5441  
<http://www.intergraph.com>  
**Circle 1150 on Inquiry Card.**

**3Demon SX48** .....\$2385  
(4 MB of VRAM, 8 MB of DRAM)  
Omnicom Graphics Corp.  
Houston, TX  
(713) 464-2990  
fax: (713) 827-7540  
[omnicomp@phoenix.phoenix.com](mailto:omnicomp@phoenix.phoenix.com)  
<http://phoenix.phoenix.net:80/~omnicomp>  
**Circle 1151 on Inquiry Card.**

compliant with OpenGL and MOGLE and have built-in VGA support.

Prices for TDZ workstations, all with GLZ 3-D acceleration, start at \$9900 for a single-Pentium TDZ-30 system (less monitor) and climb to \$136,800 for the six-Pentium TDZ-60DS with GLZ6 accelerator, a 3- by 2-GB RAID system, 256 MB of system RAM, and 27-inch InterVue display monitor. Our test system—a 100-MHz dual-Pentium TDZ-40, configured with the GLZ2 accelerator, 64 MB of RAM, 2-GB hard drive, and superb InterVue 21-inch monitor—costs \$23,850. TDZ workstations ship with a quad-speed CD-ROM drive and a keyboard with built-in microphone and Altec Lansing speakers.

## 3-D Performance

Several factors affect 3-D graphics performance: the host CPU and system bus, operating system, 3-D API, and an application's ability to perform multithreaded and multiprocessing operations. As a PCI-based system, Intergraph's TDZ-40 made a good base for testing the 3Demon card; it eliminated many of these variables. We compared the 3Demon to the TDZ-40's own GLZ2 adapter, also a PCI card, under Windows NT Workstation 3.5, with both MOGLE- and OpenGL-based benchmarks.

We also compared the 3Demon with a Matrox Millennium card, both running in the same Micron 120-MHz Pentium system. Though the Millennium accelerates 3-D, it didn't yet have OpenGL drivers and thus represents a very fast 2-D graphics accelerator for comparison purposes.

To test OpenGL 3-D performance, we used the Viewperf benchmark, developed by the OpenGL Performance Characterization Committee. It gauges 3-D performance with lines, solids, shaded solids, and textures. We tested both cards at resolutions of 640 by 480 pixels and then 1024 by 768 pixels with 24-bit color. We also tested static model rendering with MOGLE using MicroStation v5.00.95 and two 3-D DGN files ("bearing cutaway" and "pool architectural" drawings). The MicroStation command functions tested on both adapters consisted of wire mesh, hidden line, filled hidden line, and con-

stant and smooth shading renders.

To put the 3-D performance of these products in perspective, the 3Demon board in its 12-bit color mode ran the Viewperf tests three to four times faster than the Matrox Millennium in its 8-bit mode at both 640 by 480 pixels and 1024 by 768 pixels. With both cards using 24-bit color, the 3Demon was only one-third to two times faster at a resolution of 640 by 480. At 1024 by 768, the 3Demon's 4 MB of VRAM wasn't enough to double buffer, and the two cards produced almost identical Viewperf results. For rotating and animating shaded models at a resolution of 1024 by 768 (or higher) with 24-bit color, you should consider the 3Demon SX88 or SX816, which have more VRAM.

Just as the 3Demon beat the Millennium, the Intergraph GLZ2 beat the 3Demon with both boards running Viewperf in the TDZ-40—at least during most tests. In 12-bit color mode, the 3Demon speeded up and averaged roughly the same as the GLZ2 (always in 24-bit mode), but that's an unfair comparison.

The size and complexity of the MOGLE pool model made real-time Gouraud-shaded walk-throughs impossible on the SX48, though wireframe-mode pans and zooms were fluid. The GLZ2 was only 20 percent to 50 percent faster than the SX48 when first running the MOGLE tests. However, on second runs, with display-list caching in its spacious RAM, the GLZ2 ran an amazing three to ten times faster than the SX48 with the MOGLE pool model.

During model-ro-

tation and walk-through tests, the GLZ2, like the SX48, showed motion lags in the more complex pool model when doing Gouraud-shaded pans and zooms. But in wireframe and flat shaded modes, motion was fluid. Rotations of the MOGLE bearing-cutaway model at both resolutions and using Gouraud shading were less jerky with the GLZ2 than with the SX48. With the GLZ2, rotations were as smooth as glass in wireframe and flat shaded modes.

Though a bit pricey, an Intergraph TDZ workstation with GLZ acceleration technology is the top professional 3-D solution if you want the software compatibility provided by an Intel-based system. For budget-conscious people running existing 3-D applications on a PCI-based system, Omnicomp's 3Demon add-in boards are an excellent low-cost solution. ■

*Greg Loveria writes and consults on animation and 3-D graphics from Binghamton, New York. You can reach him on the Internet at [gloveria@spectra.net](mailto:gloveria@spectra.net) or [loveria@bix.com](mailto:loveria@bix.com).*

## TECHNOLOGY FOCUS

### A Whole Lotta Buffers

While a single smart processor like the Glint 300SX can speed up 3-D rendering substantially, there's no substitute for lots of buffer space. Like other Intergraph GLZ adapters, the 24-MB GLZ2 employs a 220-bit-wide memory bus to service 92 video planes consisting of two 24-bit RGB buffers (double buffering for smooth animation) and one 24-bit Z-buffer that caches depth information. Masking, overlay, and image window-control bits account for the remaining 20 video planes.

The GLZ2 uses four custom proprietary Intergraph ASIC subsystems for 2-D and 3-D graphics acceleration. The DMA Engine is the main graphics acceleration processor; according to Intergraph, it touts 3-D speeds of up to 450,000 Gouraud-shaded triangles per second. The PCI/DMA ASIC controls vertex data flow (the vertices of surface polygons) up to burst speeds of 4 MBps to and from the PCI bus and the GLZ2's 24 MB of VRAM to the FIFO chip subsystem.

The four-ASIC Resolver subsystem controls RGBA (RGB and Alpha channel) pixel and Z-data I/O to the frame buffer. A 256-bit-wide Analog Devices ADV7160 DAC handles color conversion.



Omnicom's 3Demon SX48 provides substantial acceleration with OpenGL, but the TDZ-40's GLZ2 subsystem (pictured) is faster still. The SX48 keeps up only in its 12-bit color mode, which isn't a fair comparison.



# WHEN IT COMES TO YOUR COMPANY'S WORKSTATIONS, SPEED IS MONEY!

Increase the processing speed of your SPARC® workstations or servers and you get more work done in the course of the day — simple, right?

Unfortunately, the decision about how to increase your workstation's or server's processing speed usually complicates matters. Until now, that is. ROSS Technology proudly announces the 125 MHz hyperSPARC™ Upgrade, available in single, dual and quad processor configurations. These Upgrades improve the performance and add multiprocessing capability to SPARCstation™ 10, SPARCstation 20 and SPARCserver™ 630/670/690 machines.

Not only are ROSS SPARC Upgrade processors the fastest on the market, they are a risk-free way to upgrade your workstation and server performance. ROSS is the original source of Sun's multiprocessors, and we are currently powering Sun's highest-performance desktop workstations.

**How Fast? Way Fast.** At ROSS we say, "When in doubt, check the data." Compare ROSS' numbers with the performance of major high-end SPARC microprocessors, as reported by Dataquest:

	SPECint 92	SPECfp 92
hyperSPARC 125 MHz	133	154
MIPS 175 MHz	130	100
Alpha 166 MHz	108	135
superSPARC 75 MHz	126	121
microSPARC-II 100 MHz	75	65

Think about what this means for your business. You can extend the useful life of your machines for minimal cost. You'll see performance increases in the range of two to five times current processing speed, while leaving the chassis, memory, disk and peripherals intact. Our hyperSPARC Upgrades feature compact multi-die packaging, which

allows each MBus slot to contain up to two processors; they take less than 30 minutes to install.

Most importantly, ROSS will continue to produce Upgrades that keep your SPARC workstations and servers on the blazing edge. Call your ROSS representative today to get more details on hyperSPARC multiprocessing, or send e-mail to [ross\\_info@ross.com](mailto:ross_info@ross.com).

**1-800-774-ROSS**  
**<http://www.ross.com>**

**ROSS**  
TECHNOLOGY, INC.

ROSS Technology, Inc.  
5316 Hwy. 290 W., Austin, TX 78735  
1-800-774-ROSS in U.S. • 512-919-5207 Global  
512-919-5200 Fax



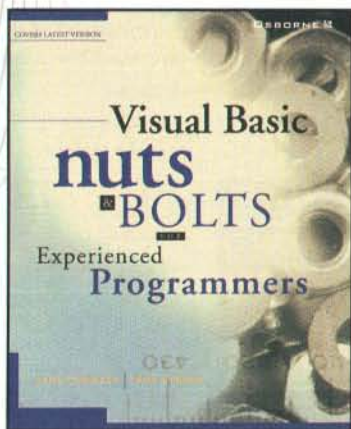
# WHEN IT COMES TO CD-ROM... WE WROTE THE BOOK

BYTE Guide to CD-ROM, Second Edition  
by Michael Nadeau  
Includes One CD-ROM Disc  
\$39.95 USA  
ISBN: 0-07-882104-5

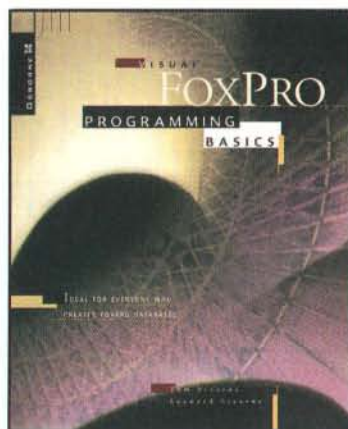
Now Fully Revised & Expanded!

This Exclusive  
Book/CD-ROM Package Includes  
• CD-ROM Buyer's Guide with Over  
400 Reviews of CD-ROM Titles  
• Demos & Samples of CD-ROM Applications

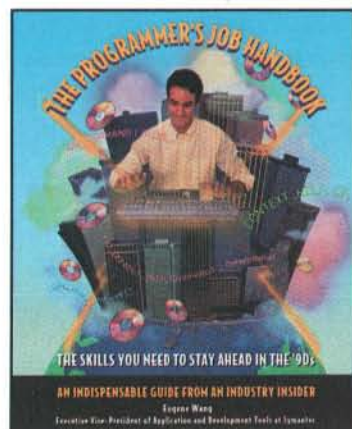
Part buyer's guide, part standards guide,  
and part trouble-shooter, the *BYTE Guide to  
CD-ROM, Second Edition* discusses all  
aspects of this burgeoning technology so  
you can take full advantage.



Visual Basic Nuts & Bolts: For  
Experienced Programmers  
by Gary Cornell and Troy Strain  
\$24.95 USA  
ISBN: 0-07-882141-X



Visual FoxPro Programming Basics  
by Tom Stearns and Leonard Stearns  
\$24.95 USA  
ISBN: 0-07-882092-8



The Programmer's Job Handbook: The  
Skills You Need to Stay Ahead in the '90s  
by Eugene Wang  
\$24.95 USA  
ISBN: 0-07-882137-1

OSBORNE 

Available now at your local book and computer stores or call 1-800-822-8158.  
Use your American Express, VISA, Discover, or MasterCard.



# AT NATIONWIDE STORES

BYTE/OSBORNE BOOKS ARE AVAILABLE AT THE FOLLOWING LOCATIONS

BARNES & NOBLE

BEST BUY

BOOKSTAR

BORDERS

COMP USA

ELEK-TEK

MEDIA PLAY

MICRO CENTER

SOFTWARE, ETC.

SUPER CROWN

TAYLORS

WALDENBOOKS

**ARIZONA**  
Tempe  
Computer Library  
PH: 602-820-0458

**CALIFORNIA**  
Capitola  
Capitola Book Cafe  
PH: 408-462-4415  
FAX: 408-462-2536

**Cupertino**  
A Clean Well Lighted Place  
PH: 408-255-7600

Stacey's Professional  
Bookstore  
PH: 408-253-7521  
FAX: 408-253-5861

**Irvine**  
Irvine Sci-Tech Books  
PH: 714-733-1002  
FAX: 714-733-0122

**Los Angeles**  
OPAMP Technical Books  
PH: 800-464-4322  
FAX: 213-464-0977

**Menlo Park**  
Kepler's Books &  
Magazines  
PH: 415-324-4321

**Mountain View**  
Tower Books  
PH: 415-941-7300

**Palo Alto**  
Stacey's Professional  
Bookstore  
PH: 415-326-0681  
FAX: 415-326-0693

**Sacramento**  
Tower Books  
2538 Watt Avenue  
PH: 916-481-6600

**San Diego**  
San Diego Technical  
Book, Inc.  
PH: 800-346-0071  
FAX: 619-279-5088

**San Jose**  
Computer Literacy  
Bookshops  
PH: 408-435-1118  
EMAIL: info@clbooks.com

**San Luis Obispo**  
El Corral Bookstore  
CAL Poly SLO  
PH: 805-756-1101  
FAX: 805-756-5351

**Santa Barbara**  
Earthling Bookshop  
PH: 805-965-0926

**Stanford**  
Stanford Bookstore  
Stanford University  
PH: 800-533-2670

**COLORADO**  
Boulder  
Biblio Tek  
PH: 303-443-7037

**Colorado Springs**  
McKinzie-White  
Booksellers  
PH: 719-590-1700  
FAX: 719-531-7631

**Denver**  
Auraria Book Center  
PH: 303-556-3230

Tattered Cover Bookstore  
PH: 303-322-7727

**Englewood**  
Softpro Books  
PH: 303-740-7751  
FAX: 303-740-8152

**DELAWARE**  
Newark  
University Bookstore  
University of Delaware  
PH: 302-831-2637

**GEORGIA**  
Atlanta  
Engineers Bookstore  
PH: 404-221-1669  
FAX: 404-221-1119

**HAWAII**  
Honolulu  
Honolulu Book Shops  
PH: 808-536-9512  
FAX: 808-538-7580

**IDAHO**  
Moscow  
University of Idaho  
Bookstore  
University of Idaho  
PH: 208-885-6469

**IOWA**  
Ames  
Iowa State University  
Book Store  
PH: 515-294-5684  
FAX: 515-294-5669

**MARYLAND**  
College Park  
University Book Center  
University of Maryland  
PH: 301-314-7855  
FAX: 301-403-8326

**MASSACHUSETTS**  
Boston  
Waterstone's Booksellers  
PH: 617-859-7300  
FAX: 617-437-0997

**Cambridge**  
Harvard/Co-Operative  
Society  
PH: 617-499-2000  
FAX: 617-868-7038

Wordsworth Books  
PH: 617-498-0080  
FAX: 617-354-4674

**Worcester**  
Tatnuck Bookseller/  
Databooks  
PH: 800-642-6657  
FAX: 508-756-9425

**MINNESOTA**  
Minneapolis  
Baxter's Books  
PH: 612-339-4922  
PH: 800-626-1049  
FAX: 612-339-6134  
EMAIL:  
tombaxter@aol.com

**NEBRASKA**  
Lincoln  
Nebraska Bookstore  
PH: 402-476-0111  
FAX: 402-476-0111

**NEW JERSEY**  
Newark  
Newark Book Center  
PH: 201-642-7956  
FAX: 201-642-3345

**Princeton**  
Princeton University Store  
PH: 609-921-8500  
FAX: 609-924-9651

**NEW YORK**  
Blasdel  
Village Green Bookstore  
PH: 716-827-5895  
FAX: 716-827-5898

**Fairport**  
Village Green Bookstore  
PH: 716-425-7950  
FAX: 716-425-4968

**New York**  
Barnes & Noble #200  
PH: 212-807-0099

**Classic Bookstore**  
PH: 212-466-0668  
FAX: 212-466-0363

**Computer Book Works**  
PH: 212-385-1616  
FAX: 212-385-8193

**McGraw-Hill Bookstore**  
PH: 212-512-4100  
FAX: 212-512-4105

**Tower Books**  
PH: 212-228-5100  
FAX: 212-228-5338

**Rochester**  
Total Information, Inc.  
PH: 716-254-0628  
FAX: 716-254-0153

**World Wide News**  
PH: 716-546-7146

**NORTH CAROLINA**  
Chapel Hill  
Bull's Head Bookshop  
PH: 919-962-5060  
FAX: 919-962-7392

**OHIO**  
Cincinnati  
University of Cincinnati  
Bookstore  
PH: 513-556-1800  
FAX: 513-556-5555

**Dayton**  
Books & Co.  
PH: 513-298-6540  
FAX: 513-298-7895

**Wilkie's South**  
PH: 513-434-8821

**Kent**  
Kent State University  
Bookstore  
PH: 216-672-2762  
FAX: 216-672-3758

**Lima**  
Readmore's Hallmark  
2100 Harding Hwy  
PH: 419-229-2601

**OREGON**  
Beaverton  
Book Vault  
PH: 503-646-8119  
FAX: 503-646-4459

**Corvallis**  
Oregon State University  
Bookstore  
PH: 503-737-4323  
FAX: 503-737-3395

**Portland**  
Portland State Bookstore  
PH: 503-226-2631  
FAX: 503-725-3800

**Tower Books**  
PH: 503-253-3116  
FAX: 503-253-4189

**PENNSYLVANIA**  
Edwardsville  
Village Green Bookstore  
PH: 717-283-9340  
FAX: 717-283-9367

**King of Prussia**  
Gene's Books, Inc.  
PH: 610-265-6210  
FAX: 610-265-6260  
EMAIL:  
genes1@netaxs.com

**Philadelphia**  
Tower Books  
PH: 215-925-9909  
FAX: 215-923-5969

**Pittsburgh**  
Carnegie Mellon  
University Shoppe  
PH: 412-268-2966  
FAX: 412-268-5592

**West Chester**  
Chester County Book  
Company  
PH: 610-696-1661  
FAX: 610-429-9006

**TENNESSEE**  
Knoxville  
University Book &  
Supply Store  
University of Tennessee  
PH: 615-974-1049

**TEXAS**  
Arlington  
University Bookstore  
University of Texas  
Arlington  
PH: 817-273-2785

**Dallas**  
Major's Scientific Books  
PH: 214-631-4478

**Denton**  
University Bookstore  
University of North Texas  
PH: 817-565-2592

**Houston**  
Major's Scientific Books  
PH: 713-522-1361  
FAX: 713-524-5860

**VIRGINIA**  
Blacksburg  
Volume II Bookstore,  
Virginia Tech  
PH: 703-231-5991  
FAX: 703-231-7786

**WASHINGTON**  
Bellevue  
Tower Books  
PH: 206-451-1110  
FAX: 206-454-0453

**Bellingham**  
Students Cooperative  
PH: 206-650-3958

**Seattle**  
Elliot Bay Book Co.  
PH: 206-624-6600  
FAX: 206-343-9558

**University Bookstore**  
PH: 206-634-3400  
FAX: 206-634-0810

**WASHINGTON DC**  
Washington DC  
Reiter's Scientific &  
Professional Books  
PH: 800-537-4314  
FAX: 202-296-9103

**WISCONSIN**  
Milwaukee  
Harry W. Schwartz  
Bookshop  
PH: 414-274-6400  
PH: 800-236-7323  
FAX: 414-274-6408



## HANDS-ON TESTING

# 16 FAST, RELIABLE RAID SUBSYSTEMS

If network server downtime has you singing the blues, the disk array subsystems tested here will keep you and your organization up and running

MICHELE GUY

**Y**our organization's network file server dies. Day-to-day operations are paralyzed. What do you do? This scenario occurs more and more frequently in today's office environments. However, the trends in computer use (e.g., centralizing data and applications on file servers and downsizing from mainframes to PC-size servers) mean that more companies are no longer tolerating server downtime—they want a solution. We tested 16 fast and reliable disk array subsystems that deliver multi-gigabyte storage and ensure that the data on your file server is always available. The price for this kind of insurance starts at about \$10,000.

The disk arrays we tested employ a data storage technology called RAID (redundant array of independent disks). RAID addresses three key aspects of disk storage: (1) capacity, (2) speed, and (3) reliability. A disk array connects multiple smaller-capacity drives into a device that can appear to an OS as a large, sin-

gle logical drive. The overall speed is better on these drives than on a large single drive because the heads on the smaller-capacity drives travel a shorter distance to perform read/write operations, and multiple drives support multiple simultaneous read/writes. RAID controller hardware provides data redundancy to improve reliability, either with a second mirrored copy of the original data or through various parity schemes; this allows a RAID array to continue to operate if one drive fails. (Unlike most other components in a computer, fixed drives contain moving

## How to use this guide

We selected the best disk array subsystems by evaluating speed, features, and usability.

The Overall Score combines a product's weighted scores for performance (i.e., speed), features, and usability. Performance counted for half of the overall score; features and usability each was one-fourth of the overall score.

We evaluated the disk arrays on their features (e.g., warranty length and coverage), number of redundant and hot-swappable components, support for a hot spare drive, and alarm types.

**BEST OVERALL** Digital StorageWorks RAID Array 230 Subsystem

The Digital StorageWorks RAID Array 230 Subsystem was the clear winner in this category. Its fast performance and wide range of features, including redundant and hot-swappable drives, power supplies, fans, a sixth drive for a hot spare, and a write cache with battery backup, placed it well above the other subsystems. Its Online Management Utility for Windows NT provides an exact and readable status during a drive failure and rebuild operation.



Usability was judged on the quality of documentation, ease of configuration, and the ease with which the array was able to recover from a single drive failure.

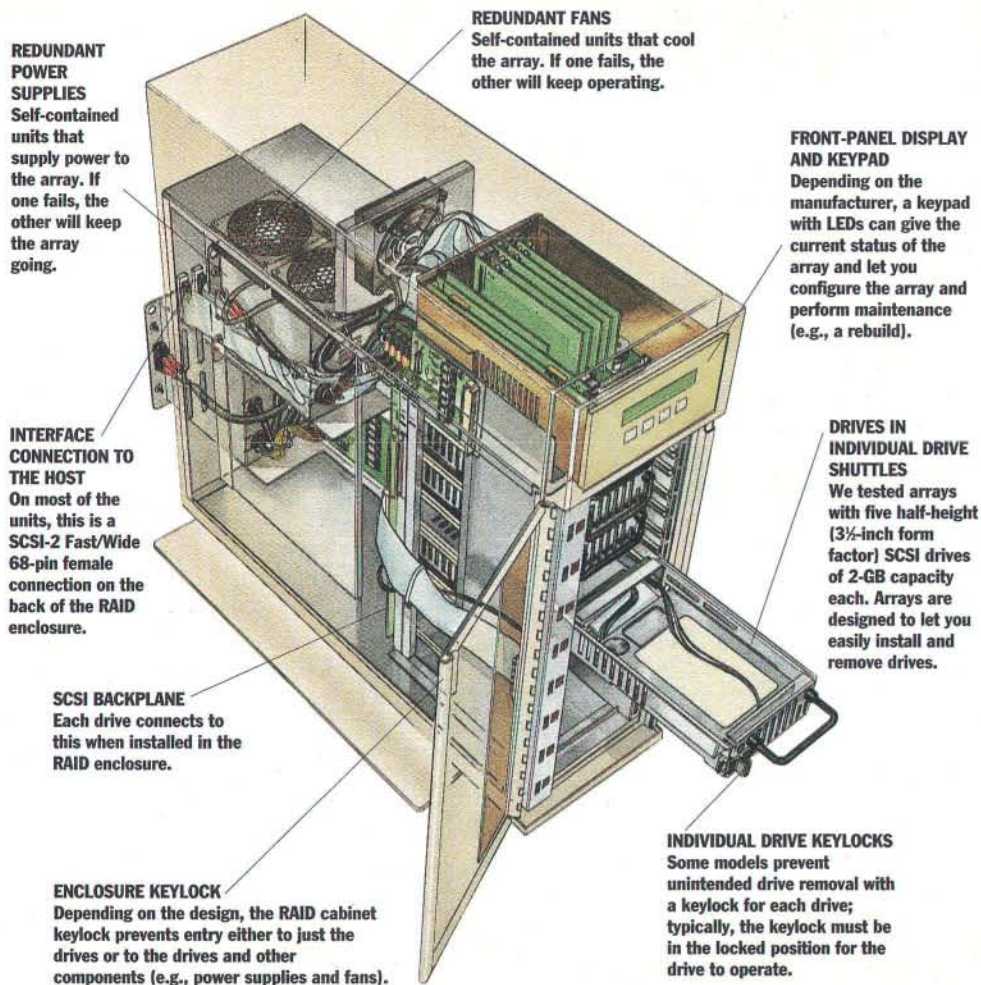
		PRICE	OVERALL EVALUATION SCORE	FEATURES	USABILITY	OVERALL	PERFORMANCE INDEX	
							SINGLE-THREAD	MULTI-THREAD
BEST	DEC StorageWorks RAID Array 230	\$12,183	7.97	AAAA	AAAA	7.61	7.77	7.45
RUNNER-UP	Mega Drive Enterprise E-8 PCI	\$11,900	7.05	AAAA	AAAA	6.28	7.60	4.90
RUNNER-UP	Storage Solutions Roca-Ray CM2+	\$13,595	7.05	AA	AAAA	7.17	6.08	8.26
RUNNER-UP	Conner CR12-RAID	\$16,595	6.58	AAA	AAA	5.47	4.69	6.26
RUNNER-UP	Winchester Systems FlashDisk SCSI	\$15,737	6.55	AAA	AA	6.18	6.11	6.26

Relative speed on a scale of 1 to 10 in a single-thread and a multithread environment.

Relative overall speed on a scale of 1 to 10.



## A Pillar of Reliability



parts that make them more susceptible to failure).

RAID was originally defined as having five different levels. Each level addresses the issue of data redundancy in a different way. RAID level 1, which mirrors data, and RAID 3 and 5, which store parity information (also known as ECCs, or error-correction codes), are the most commonly used RAID implementations (for more on RAID level definitions, see the text box "On the Levels" on page 259).

We configured the arrays in our test to use RAID 5, which gives you a reasonable trade-off between cost and performance. RAID 5 distributes data and ECCs across the entire array (see the text box "How Error Correction Works" on page 250). RAID 1 offers faster performance but at a higher per-megabyte price, because half of the total storage space is sacrificed to the mirrored data. On a typical five-drive RAID 5 array, parity information takes up only about 20 percent of total storage space. However, some performance is sacrificed because writes to disk must also include an addi-

tional operation to update parity information.

When RAID was first conceived at the University of California at Berkeley in 1987, the *I* in RAID stood for *inexpensive*. One of the original motivating forces for the RAID developers was to create the most storage for the lowest cost. They found it was cheaper to string several small-capacity drives together than it was to use a single, large expensive drive. Today, companies are more likely to use disk arrays for their redundancy features than to achieve cost savings. Large-capacity drives are no longer necessarily more expensive than an array made up of smaller-capacity drives. As the price-per-megabyte of disk storage continues to fall due to ever-cheaper drives, more users may find a RAID 1 mirrored drive configuration as economical as a RAID 3 or a RAID 5 solution. Another trend may make the focus on RAID levels less crucial. So-called adaptive RAID controllers that dynamically select the best RAID level, using whichever level is optimal for a given set of data, may soon be available.

SEPTEMBER 1995  
**BYTE**  
BEST  
DISK  
ARRAYS

**BEST**

### BEST OVERALL

#### Digital StorageWorks RAID Array 230 Subsystem

The Digital StorageWorks RAID Array 230 Subsystem has it all—superior speed and features at a reasonable price. Its sleek enclosure houses redundant and hot-swappable disks, power supplies and fans, and a battery-secured write cache. It also supports a hot spare drive. **PAGE 250**

### BEST FOR DATABASE SERVERS

#### Digital StorageWorks RAID Array 230 Subsystem

The StorageWorks RAID Array 230 Subsystem outperformed the competition in handling transactions typical in a database server environment. **PAGE 252**

### BEST FOR AUDIO/VIDEO SERVERS

#### Digital StorageWorks RAID Array 230 Subsystem

When it came to our audio/video benchmarks, the StorageWorks RAID Array 230 Subsystem was only the third-fastest subsystem, but its features and usability put it over the top once again. **PAGE 256**



## BEST OVERALL

## DISK ARRAYS

Each of the 16 disk arrays we tested, with a few minor exceptions, consisted of a case enclosing an array of five half-height 2-GB drives, an array controller board or comparable hardware, a power supply and fan, and a configuration utility and LCD panel that lets you select the RAID level and make other array configuration selections. Most products provided some additional level of hardware redundancy, such as a sixth drive to be used as a hot spare, a second power supply, fan, controller, or some combination of these. All these arrays were designed to survive a single-drive failure.

For RAID 5 testing, we connected each array to a file server running Microsoft Windows NT 3.5 and formatted the array as one large drive (the formatted capacity of these arrays averaged about 8 GB). We ran a series of automated low-level disk tests that were designed to simulate the real-world conditions found on a typical disk subsystem connected to a PC file server.



From left: Winchester Systems' FlashDisk, Mega Drive's Enterprise, Conner's CR12-RAID, Storage Solutions' Raca-Ray, and Digital's StorageWorks.

The Best Overall winner is Digital Equipment's StorageWorks RAID Array 230 Subsystem. The StorageWorks had the fastest performance and the widest range of features, including redundant and hot-swappable drives, power supplies, fans, a drive for a hot spare, and a write cache with battery backup. The three-channel controller is designed to install in a PCI-based file server and can support two additional enclosures for up to 90.3 GB

of storage. The StorageWorks' Online Management Utility for NT does a good job of giving you an exact and readable status during a drive failure and rebuild operation. The StorageWorks is also one of the least-expensive units we tested.

The second- and third-ranked products from Mega Drive and Storage Solutions, respectively, had virtually identical overall scores. Of the two, the Storage Solutions' Raca-Ray CM2+ was faster and had the best multithread performance score of any array we tested. The Raca-Ray's speed comes in a not-so-glamorous package; its drives sit in open, trackless

## HOW ERROR CORRECTION WORKS

RAID 5 uses a technique that (1) writes a block of data across several disks (i.e., striping), (2) calculates a code from this data and stores the code on another disk (i.e., parity), and (3) in the event of a single-disk failure, uses the data on the working drives and the calculated code to "interpolate" what the missing data should be (i.e., rebuilding). A RAID 5 array "rotates" data and parity among all the drives on the array, in contrast with RAID 3, which stores all calculated parity values on one particular drive. The following is a simplified explanation of how RAID 5 calculates ECCs (error-correction codes).

Say, for example, that you have a five-drive array on which you intend to store four values: The numbers 172, 106, 240, and 156. For the purpose of this example, the RAID controller stores the value 172 as the binary number 10101100 on disk 1 of the array, the value 106 as the binary number 01101010 on disk 2, and so on as shown in the table "Error Detection: Bit by Bit" at right. When our four values have been written to disks 1 through 4, the RAID controller examines the sum of each bit position. If the sum of the numbers of bit position  $x$  on disks 1 through 4 is an odd number, then the value of that bit position on disk 5 is assigned a 1; if the sum is an

even number, the bit position on disk 5 is assigned a 0.

Now assume that disk 2 fails. The RAID controller can no longer see the value 0 at bit 7 on disk 2. However, the controller knows that its value can be only a 0 or a 1. And as disks 1, 3, 4, and 5 are still operating, the controller can perform the following calculation:  $1 + ? + 1 + 1 = \text{an odd number}$ . Since  $1 + (0) + 1 + 1 = \text{an odd number (3)}$ , the missing value on disk 2 must be 0. The RAID controller then performs the same calculation for the remaining bit positions. In this way, data missing due to a drive failure is rebuilt.

## ERROR DETECTION: BIT BY BIT

A RAID controller examines the sum of each bit position to assign an even or an odd number to disk 5. If a disk fails, it assigns a 0 or a 1 to the missing value and performs a simple calculation. It repeats this process across each bit position, rebuilding the data as it goes.

CONTENTS		BIT 7	BIT 6	BIT 5	BIT 4	BIT 3	BIT 2	BIT 1	BIT 0
ON DISK:									
Disk 1	172	1	0	1	0	1	1	0	0
Disk 2	106	0	1	1	0	1	0	1	0
Disk 3	240	1	1	1	1	0	0	0	0
Disk 4	156	1	0	1	1	1	1	0	0
Sum		odd	even	even	even	odd	even	odd	even
Disk 5 (parity)		1	0	0	0	1	0	1	0



In a class all its own...

## BEST OVERALL

### Digital StorageWorks RAID Array 230 Subsystem



The Digital StorageWorks RAID Array 230 Subsystem was the clear winner in this category. Its fast performance and wide range of features, including redundant and hot-swappable drives, power supplies, fans, a sixth drive for a hot spare, and a write cache with battery backup, placed it well above the other subsystems. Its Online Management Utility for Windows NT provides an exact and readable status during a drive failure and rebuild operation.



		PRICE	OVERALL EVALUATION SCORE	FEATURES	USABILITY	PERFORMANCE INDEX		
						OVERALL	SINGLE-THREAD	MULTI-THREAD
BEST	DEC StorageWorks RAID Array 230	\$12,183	7.97	★★★★	★★★★	7.61	7.77	7.45
RUNNER-UP	Mega Drive Enterprise E-8 PCI	\$11,900	7.06	★★★	★★★★	6.28	7.60	4.96
RUNNER-UP	Storage Solutions Raca-Ray CM2+	\$13,595	7.05	★★	★★★	7.17	6.08	8.26
RUNNER-UP	Conner CR12-RAID	\$16,593	6.56	★★★	★★★	5.47	4.69	6.26
RUNNER-UP	Winchester Systems FlashDisk SCSI	\$19,737	6.55	★★★	★★	6.18	6.11	6.26

## Riding high on value

### LOW-COST

### Digital StorageWorks RAID Array 230 Subsystem



With its test-configuration price of \$12,183, the Digital StorageWorks RAID Array 230 Subsystem is an excellent value. For this price, you get five drives and a sixth spare drive, a second power supply and fan, battery-protected write cache, monitoring utilities for Windows NT and NetWare, a one-year on-site warranty and a five-year warranty on the disk drives. Offering many of the same features is the \$11,900 Mega Drive Enterprise E-8 PCI. The Enterprise has a standard two-year warranty and comes shipped with a DAT (digital audiotape) drive module in addition to its five-drive array and one spare drive.

		PRICE	OVERALL EVALUATION SCORE	FEATURES	USABILITY	PERFORMANCE INDEX		
						OVERALL	SINGLE-THREAD	MULTI-THREAD
BEST	DEC StorageWorks RAID Array 230	\$12,183	7.97	★★★★	★★★★	7.61	7.77	7.45
RUNNER-UP	Mega Drive Enterprise E-8 PCI	\$11,900	7.06	★★★	★★★★	6.28	7.60	4.96
RUNNER-UP	Procom LANForce-5	\$10,255	5.97	★★★	★★★★	3.91	4.67	3.15
RUNNER-UP	Raidtec FlexArray FX	\$11,195	5.61	▲	★★★★	4.24	4.34	4.14
RUNNER-UP	DPT SmartRAID Subsystem	\$12,615	4.94	★★	★★★★	2.08	2.59	1.57

Weighting for Best Overall

PERFORMANCE 50%

FEATURES 25%

USABILITY 25%

The CR12-RAID uses a dual-channel controller, supports redundant hot-swappable drives, power supplies, and fans, and can be configured with up to 12 drives. It also has graphical monitoring utilities for NT and NetWare and a five-year warranty on both its drives and subsystem.

tooled to correct this glitch.

Placing fourth and fifth, with nearly identical overall scores, were the CR12-RAID by Conner Storage Systems and the FlashDisk SCSI by Winchester Systems. The

The Winchester FlashDisk SCSI offered better overall performance than the CR12-RAID but is priced considerably higher than the other top five subsystems. The FlashDisk is sold in configurations with up to 128 GB of storage capacity.

If you're on a budget, two of our previously mentioned winners—the Digital StorageWorks and the Mega Drive Enterprise—are priced at under \$13,000. At \$10,255, Procom Technology's LANForce-5 was the lowest-priced unit tested here. The LANForce-5 offers full redundancy and hot-swapping components—drives, power supplies, fans, and controllers, as well as a sixth drive for a hot spare—but its perfor-

mance was below average. The company reports that a new high-performance controller will be available for this product this summer.

In analyzing the performance of these subsystems, it's apparent that RAID controllers play a major role. Three of the top-ranked arrays—Digital, Mega Drive, and Conner—use various models of controller from Mylex. It's interesting to note that write-caching didn't determine who made our top-five list. As neither the Raca-Ray nor the CR12-RAID had battery backups, their performance scores were based on their "write-cache off" results, and both still made the grade. As for reliability, participating

#### KEY

Ratings from 1 to 4: ▲ is the lowest; ★★★★★ is the highest.

vendors quoted the MTBF (mean time between failures) of the individual drives in these arrays as ranging from 500,000 to 1,000,000 hours. All the arrays we tested successfully withstood a simulated single-drive failure. Our tests did not measure the relative drop in performance that these arrays would experience while in rebuild mode (also known as degraded mode). On many arrays, when configuring the array, you can determine the rate of rebuild; the faster the rebuild, the more current server performance is slowed.



# Best for Database Servers

**D**atabase servers are the computer workhorses of many organizations. Whether you're running an order-entry application in a manufacturing facility or trying to do inventory control for a supermarket, you need disk storage that's big, fast, and reliable.

We analyzed our benchmark scores to determine which of the 16 products tested perform best when connected to a database server. Our benchmark recorded the minimum, maximum, and average time it took to perform random and sequential reads and writes at various points in the array. Using the average times, we calculated scores that reflect how fast the disk arrays performed relative to one another. Our tests simulate two types of environments: single-thread and multithread, which approximate single- and multiuser workloads. When calculating scores,

we gave more weight to sequential operations than to random ones to reflect the importance of such tasks as reading in a large data file or loading an executable file.

Digital Equipment's StorageWorks RAID Array 230 Subsystem had the best overall performance and the best single-thread performance in this category. Storage Solutions' Raca-Ray and the Mega Drive Enterprise came in second and third, respectively. On nearly every multithread task, the Raca-Ray's score was the fastest. As in its overall score, the Enterprise handled single-thread tasks much better than multithread ones.



Digital StorageWorks RAID Array 230 Subsystem

In fourth place was the Nordique Open Storage Facility by StorageTek Distributed Systems. The Nordique is sold as a stand-alone or as a component of the Nordique 9100, a modular RAID 5 system for users downsizing from a mainframe to a Unix or PC network. The Nordique was the slowest and most expensive subsystem of the top five, but its features and usability allowed it to edge out the faster Winchester FlaskDisk SCSI. Data is protected by redundant and hot-swappable drives, power supplies, fans, and controllers. The Nordique also offers battery backup and support for a hot spare.



## DIGITAL STORAGEWORKS RAID ARRAY 230 SUBSYSTEM

The Digital StorageWorks RAID Array 230 Subsystem was fastest in tests that simulate a database environment. The StorageWorks' performance was the best of the arrays in our single-task tests and second-best in our multitasking tests. The Raca-Ray CM2+ from Storage Solutions was the fastest array at handling multiple processes, but it ranked fifth in single-task speed.

	PRICE	OVERALL EVALUATION SCORE	FEATURES	USABILITY	PERFORMANCE INDEX		
					OVERALL	SINGLE-THREAD	MULTI-THREAD
DEC StorageWorks RAID Array 230	\$12,183	8.62	★★★★	★★★★	8.91	8.76	9.06
Storage Solutions Raca-Ray CM2+	\$13,595	7.36	★★	★★★★	7.78	5.91	9.66
Mega Drive Enterprise E-8 PCI	\$11,900	7.34	★★★★	★★★★	6.83	8.41	5.26
StorageTek Nordique Open Storage Facility	\$27,000	6.82	★★★★	★★★★	5.17	4.78	5.56
Winchester Systems FlashDisk SCSI	\$19,737	6.81	★★★	★★	6.72	6.64	6.79

**Key:** Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

## FILE SERVERS WITH RAID

If you're in the market for a new file server and a disk array, you might consider a file server with a built-in array. We looked at two: the AST Manhattan P Series 5090 and the Compaq ProLiant 2000 M4200A.

The AST Research ((714) 727-4141) Manhattan is a 90-MHz Pentium EISA/PCI (peripheral component interconnect) bus server that uses the DPT SmartRAID PM3224 PCI controller. The DPT controller has a graphical configuration utility called Storage Manager, which also handles event logging and user notification of error conditions. The AST Manhattan ships with Percepta, a server manager and monitoring utility for Windows NT or NetWare. The status of the disk array can be monitored from Percepta, which uses SNMP traps to hook DPT's Storage Manager. SmartRAID supports RAID 0, 1, and 5, a maximum cache of 64 MB, and hot swapping of drives. The AST Manhattan we tested was shipped with five 2-GB Quantum Empire Series 2100S hard drives and a CD-ROM drive. The price of the tested unit is \$15,396.

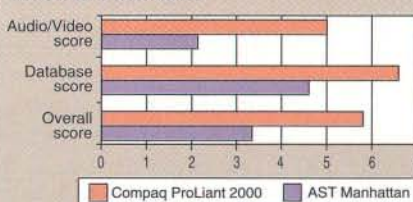
The Compaq Computer ((713) 374-0484) ProLiant has dual Pentium 90-MHz CPUs and an EISA/PCI bus, and it uses the Compaq Smart SCSI Array Controller. Our test unit had five 2.1-GB Conner C2490A drives, which can be accessed from the server's front door, and a CD-ROM drive. The front door has an internal temperature monitor and a keylock for security. Drives are hot-pluggable, and the system supports seven half-height drives for a total of 14.7

GB. The array is configured via SmartStart, Compaq's CD-ROM-based configuration utility. The price of the unit we tested is \$24,880 (the Compaq 1024 monitor is priced separately at \$369).

We configured the disk system in each file server as a RAID 5 array of three 2-GB drives and installed Windows NT 3.5 on one of the remaining 2-GB drives as a boot drive. We ran our performance benchmarks on the file servers to determine how they performed relative to one another.

In the configuration tested, the Compaq ProLiant was consistently faster than the AST Manhattan. Had the ProLiant been tested with the subsystems, it would have ranked approximately sixth in overall performance and about fourth in database performance, but it was composed of three instead of five drives.

### File Server Performance



We ran our performance tests on the file servers to determine how they performed relative to one another.



It's the  
2in1  
rewritable  
optical disk  
and CD-ROM  
drive.

It's

PowerDrive<sup>2</sup>  
from  
Panasonic.

It's the new standard  
of multimedia  
storage.

If you're thinking about buying a *backup* storage device, think *twice*. PowerDrive<sup>2</sup> gives you *both* a rewritable optical disk and *CD-ROM* in one drive. It even reads and writes like a hard drive. If you're thinking CD-ROM capabilities, think *2X*. And *4X*. PowerDrive<sup>2</sup> reads both existing *and* emerging titles. If you're thinking compatibility options, PowerDrive<sup>2</sup> gives you *two* of those as well. Its internal or external drive easily connects to any PC or Mac.

PowerDrive<sup>2</sup> from Panasonic. **It will change the way you look at multimedia storage, forever.** For more information on the new Panasonic PowerDrive<sup>2</sup>, call 1-800-742-8086, and ask for ext. PD.



All other brand and company/product names are trademarks or registered trademarks of their respective companies.

**Circle 79 on Inquiry Card.**

**Panasonic**  
Communications & Systems Company  
PD-BY



# How We Tested

**W**e invited each vendor to supply a disk array subsystem with five drives that have a total capacity of 10 to 12 GB, configured as a RAID 5 array. Although it wasn't required of them, some vendors also supplied a sixth drive to act as a hot spare. We specified that the subsystem's interface to the host be SCSI-2 Fast/Wide. Of the 16 products tested, 10 had RAID controllers built into their enclosures; eight of these products supported a SCSI-2 Fast/Wide single-ended termination and the other two supported differential termination. To connect the single-ended subsystems, we installed an Adaptec AHA-2940W PCI-to-Wide SCSI adapter in our test file server. To connect the differential products, we installed an NCR 8251D PCI SCSI adapter. The remaining six arrays shipped with their own RAID controller boards, which doubled as host adapters for these products.

We used a Dell PowerEdge SP590-2 system as our file server. The PowerEdge is a Pentium 90-MHz-based EISA server with two PCI (peripheral component interconnect) slots. Microsoft Windows NT 3.5 Workstation was installed on the boot drive of the Dell. We evaluated each product's performance, usability, and features, and the test results were weighted as follows: 50 percent, 25 percent, and 25 percent, respectively.

## PERFORMANCE

**W**e connected each disk array we were testing to the file server using the appropriate host adapter. We then formatted the array under NT as a single drive using the NTFS (NT File System) format. We ran a suite of performance tests under NT with the array's write-back cache off and then on (if both states were supported and could be toggled by the end user).

The performance suite simulates tasks that a disk array subsystem would perform in a real-world environment. Random and sequential reads and writes of 4-, 16-, and 64-KB blocks were performed at different locations on the array in a single-thread and a multithread environment. Except for the tests that read or wrote over the disk array, we set the number of blocks per segment so that the total size of the region under test was 128 MB.

## PERFORMANCE SCORING

**W**e recorded test results as the average, minimum, and maximum time (in seconds) required to complete each test. The average and maximum times gave performance scores; minimum times were for reference only. A product's score is relative to how it performed compared to the other products. Each product's Best for Database Servers score is a weighted average of the single-thread and multithread "average" recorded times. The Best for Audio/Video score is a weighted average of the single-thread and multithread "maximum" recorded times. The Best Overall score is an average of the database and audio/video scores. We used a product's "cache-on" times if the product was supplied with a battery-secured write cache; otherwise, we used the "cache-off" times.

## FEATURES

**W**e evaluated each product on its cost per MB of storage, warranty length and

coverage, redundant and hot-swappable components, as well as alarms, security features, and maximum storage capacity.

## USABILITY

**W**e evaluated each product's ease of set-up and configuration and the completeness and clarity of the user's manuals. We simulated a single-drive failure, verified that the file server could continue to operate normally, and evaluated the ease of performing a rebuild of the array.

## Contributors

**Michele Guy, Project Manager/NSTL**, has been testing hardware and software products for NSTL for the past four years.

**Kathleen Bishop, R&D/NSTL**, has eight years of R&D experience in the computer industry.

**Bruce Levy, Ph.D., Manager, R&D/NSTL**.

*The Lab Report is an ongoing collaborative project between BYTE magazine and National Software Testing Laboratories (NSTL). BYTE magazine and NSTL are both operating units of McGraw-Hill, Inc. Contact the NSTL staff on the Internet at [editors@nstl.com](mailto:editors@nstl.com) or by phone at (610) 941-9600. Contact BYTE on the Internet or BIX at [editors@bix.com](mailto:editors@bix.com) or at (603) 924-2624.*

## RAID ADVISORY BOARD

The RAID Advisory Board is an organization dedicated to advancing the use and awareness of RAID and associated storage technologies. Started in 1992, RAB states its main goals as education, standardization, and certification.

As a forum for discussion on developments in the storage-technology industries, RAB recently sponsored RAID '95, a conference held in San Jose, California. During the four-day event, attendees could take a course on RAID basics, learn about the latest business and technical issues, and hear discussions about predicted future trends. Among the conference speakers was Garth Gibson, one of the three original researchers responsible for proposing RAID technology.

Joe Molina, chairman of RAB, reported that one of this year's hot topics was adaptive RAID, a technology in which there is no predefined RAID; instead, the RAID subsystem makes this decision for the user, based on patterns of data use. Another hot topic was integration—that is, RAID subsystems that incorporate other types of storage media, such as tape and CD-ROM, and that utilize hierarchical storage management (e.g., automatically migrating older data off a hard drive and onto a tape jukebox).

Molina predicted that by the year 2000, almost all systems will have RAID, except notebooks and low-end stand-alones. PCMCIA RAID will become a reality, as will support for interfaces other than SCSI, such as fiber channel and arbitrated loop. (Currently, about 90 percent of RAID products are SCSI-based.) Also by the year 2000, today's cost of about \$2 per megabyte with RAID should decrease to about 25 cents per megabyte. Molina agreed that while vendors may find it difficult to make money in this kind of market, users will benefit, and there will be plenty of RAID products to choose from.



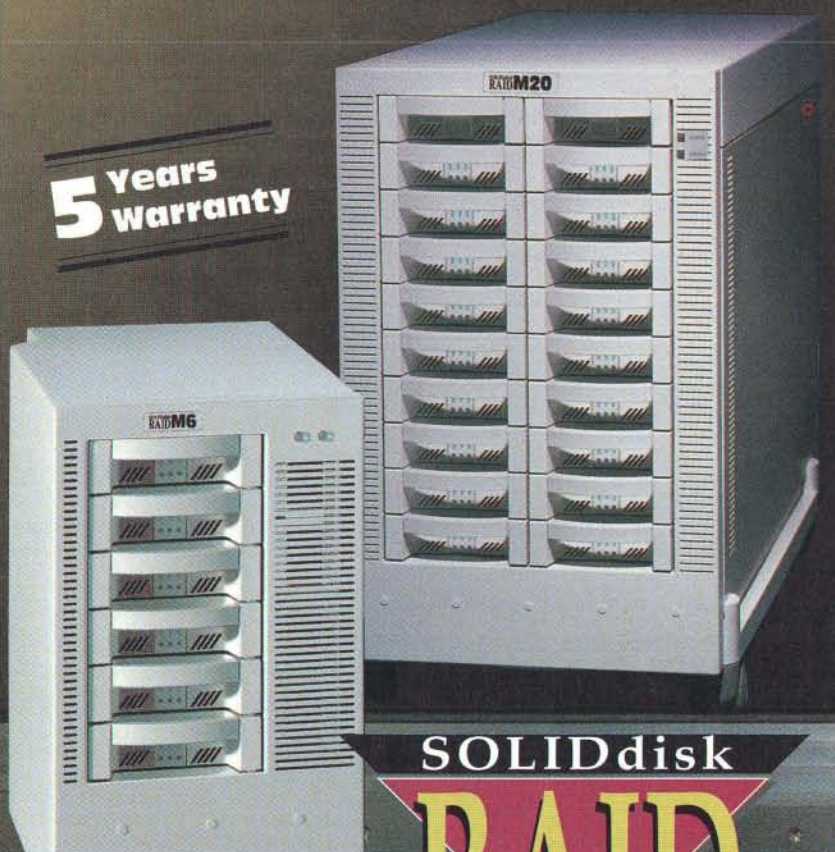
For more information on the RAID Advisory Board, contact:

Joe Molina, Chairman  
RAID Advisory Board  
13 Marie Lane  
St. Peter, MN 56082  
(507) 931-0967  
fax: (507) 931-0976  
0004706032@mcimail.com



# Safe Speed

**5 Years  
Warranty**



**SOLIDdisk**

**RAID**

**Make sure your data is fast and secure!**

You might not know how valuable your data is until it is no longer available, or even worse, it has been lost forever. If such an event were to occur, it will take valuable man-hours to restore the data, if possible, and cost your business countless dollars.

This is why you should invest in a data secure, high availability system, before it is too late!

SOLIDdiskRAID High Performance Systems leaves no room for error. SOLIDdisk RAID offers a fully redundant fault-tolerant solution, as well as the ability to have your data available continuously. This is accomplished since all of the parts, hard disks, power supplies, controllers, and ventilators, are fully redundant, and can be exchanged

during operation in case a defect occurs. The **SOLIDdisk RAID** System is a true hot swap unit. There is no down-time, no tools required, and best of all, no cost to you!

There is only one way to guarantee data security, a **SOLIDdisk RAID** System!

**Facts:** Transfer rate 20 MB/s (100 MB/s in the future). Up to 80 GB/unit. Max. 128 MB cache. Single or dual processor cache system. RAID levels 0, 1, 3 and 5. MTBDL more than 4 Mio. hours (500 years). Supported computer systems: **SUN SPARC, IBM RS/6000, Novell NetWare, HP 9000/800/900, Apple, SGI, Motorola, DEC-VAX, ALPHA.**

**Europe:** Tel. ++49-89-31 57 19 60  
Fax ++49-89-315 16 94

**Distributors:**

USA: DICKENS DATA SYSTEMS • Tel: 1-800-448-6177 • Fax: 1-404-442-7525

AUSTRIA: INFORMATION STORAGE • Tel: ++43-2231-66416-0 • Fax: ++43-2231-66416-6

BENELUX: AVANCE • Tel: ++31-3480-30688 • Fax: ++31-3480-30232



**USA:** Tel. 1-800-784-RAID  
**Internet:** <http://www.solidinfo.com>

BENELUX: AXIO • Tel: ++31-2155-11144 • Fax: ++31-2155-26580

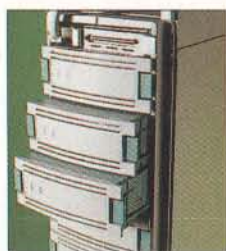
SWITZERLAND: SOLID COMPUTER • Tel: ++41-56-701230 • Fax: ++41-56-713069

CZECH. REP.: SOLID COMPUTER • Tel: ++42-2-436991 • Fax: ++42-2-434621



# Best for Audio/Video

The sound and video files used in multimedia applications tend to be large, gobbling up disk storage and placing heavy demands on disk I/O. RAID subsystems can provide the disk capacity and performance required for these applications. To determine which RAID array would perform best in an audio/video environment, we looked at the maximum recorded times of each subsystem for each test in our performance benchmark. We used the maximum recorded



Digital StorageWorks RAID Array 230 Subsystem

times, because when looking for disk storage for audio/video applications, you want a system with the least amount of slow I/O. For example, a disk array that was relatively fast, on average, but had several slow results on read tests might, in a real-world environment, result in video clips that would run correctly and then "freeze" at certain points before resuming. The result would be similar to pressing the pause button on your VCR every 10 seconds or so while trying to watch a movie.

Once again, the Digital StorageWorks

Array placed first. Although it was only the third-fastest, the StorageWorks' features and usability made the difference. The speed demon of this group was MicroNet Technology's RAIDbank Plus for PCI. The RAIDbank, which uses a dual-channel Mylex controller, had the best performance overall and fast speeds in the multithread tests. The RAIDbank features redundant and hot-swappable drives, power supplies, and a hot spare. When configuring this subsystem, we took advantage of MicroNet's walk-through service, available to all new RAIDbank users (see "Honorable Mentions" on page 259). The RAIDbank's

NT Adapter Monitor utility needs work; it did not issue an alert during our single-drive failure test. However, the Administration utility correctly detected the RAID's status as "critical," and an automatic rebuild took place as expected.

The Conner CR12-RAID and Mega Drive Systems' Enterprise E-8 PCI arrays were tied for third. The CR12-RAID performed multithread tasks faster than it did single-thread tasks, and the Enterprise handled single processes better. The Storage Solutions' Raca-Ray CM2+ was ranked fourth. It performed single-thread and multithread tasks at about the same speed.



## DIGITAL STORAGEWORKS RAID ARRAY 230 SUBSYSTEM

Even though the StorageWorks RAID Array 230 Subsystem only ranked third in our audio/video benchmarks, it was still the best overall product in features and usability compared to the other products we tested. Except for Storage Solutions' Raca-Ray CM2+, the other top-five products were either very fast in our multitasking tests—such as the RAIDbank Plus for PCI from MicroNet Technology—or fast in our single-task tests, but not both.

	PRICE	OVERALL EVALUATION SCORE	FEATURES	USABILITY	PERFORMANCE INDEX		
					OVERALL	SINGLE-THREAD	MULTI-THREAD
DEC StorageWorks RAID Array 230	\$12,183	7.32	★★★★	★★★★	6.31	6.78	5.85
MicroNet RAIDbank Plus for PCI	\$16,395	6.85	★★	★★	7.22	5.14	9.30
Conner CR12-RAID	\$16,593	6.79	★★★	★★★	5.95	4.12	7.79
Mega Drive Enterprise E-8 PCI	\$11,900	6.79	★★★	★★★★	5.72	6.79	4.66
Storage Solutions Raca-Ray CM2+	\$13,595	6.74	★★	★★★	6.55	6.25	6.85

Key: Ratings from 1 to 4: ▲ is the lowest; ▲▲▲▲ is the highest.

## SOFTWARE RAID SOLUTIONS

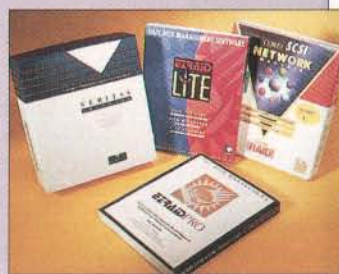
Although the focus of our tests was hardware-based RAID (i.e., subsystems that use a dedicated RAID controller), if you've already invested in storage and don't have \$10,000 or so to spend on a RAID subsystem, there are many software applications on the market that let you configure your existing disk storage as a RAID array. These software programs perform RAID calculations with the help of your server's CPU rather than relying on a dedicated RAID controller.

**For a NetWare environment:** Corel ((613) 728-8200; fax (613) 728-9790) offers Corel SCSI Network Manager with CorelRAID 2.0 for \$595. CorelRAID uses either RAID 4 or 5, can support a maximum of 16 drives, and supports the hot swapping of drives and a hot spare. Under NetWare, you can define users and groups to receive messages if a drive failure occurs. To use CorelRAID, you need a PC-compatible 386 server running NetWare 3.1x or higher, 4 MB of RAM, three SCSI hard drives, and a SCSI host adapter with ASPI (advanced SCSI programming interface).

**For an OS/2 environment:** Cyranex ((613) 738-3864; fax (613) 738-3871), formerly Pro Engineering, offers two software RAID packages for OS/2: EZRAID Pro for \$795 or EZRAID Lite for \$195. You can use EZRAID Pro with OS/2 version 2 or higher; it will

work with SCSI, IDE, ESDI, and other types of hard drives and host adapters, although Cyranex recommends using SCSI devices. You can mix different drive types and host adapters within the same array. A minimum of two hard drives is required. EZRAID Pro supports RAID 0, 1, 4, or 5, supports hot sparing, and has a remote failure notification utility and performance monitor. EZRAID Lite is designed to be used with OS/2 desktop systems only and supports RAID 0 and 1. It also supports hot sparing and comes with a performance monitor utility.

**For a Unix environment:** Veritas Software ((415) 335-8000; fax (415) 335-8050) offers VxVM (Veritas Volume Manager) 2.0, which supports RAID 0, 1, and 5 with hot spare drives. VxVM 2.0 has a GUI for such on-line disk administration tasks as monitoring disk usage and fine-tuning to handle I/O bottlenecks. VxVM costs \$1500 for desktop systems and starts at \$3500 for desktop servers.

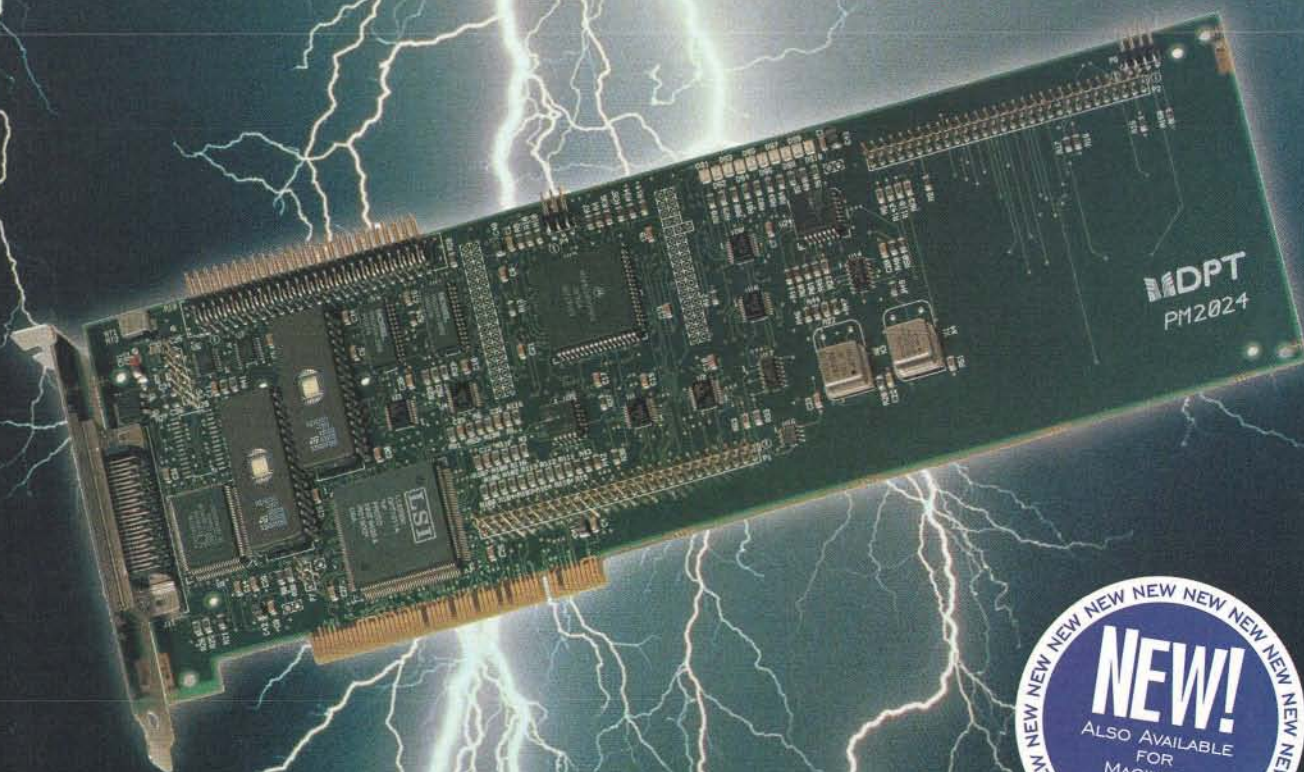


Software from Corel, Cyranex, and Veritas offers an inexpensive RAID alternative.



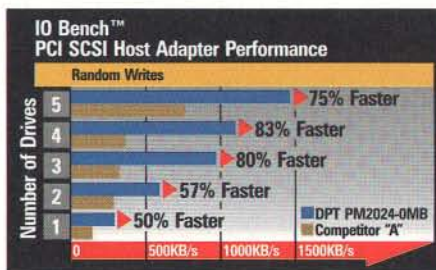
PCI SCSI ADAPTERS FROM DPT

# FAST AS LIGHTNING!



## Lightning does strike twice!

Combine DPT's PCI SCSI performance with the power of your Pentium, and watch your system sizzle. Of course you can install your DPT PCI SCSI adapters with confidence because they are fully compatible with the latest version of the PCI specification, and we have tested compatibility with thousands of products and operating systems.



For even faster performance, you can easily add hardware caching and RAID support with optional plug-on modules.

Installation couldn't be easier: all DPT PCI SCSI Adapters are Plug-and-Play ready and come complete with Storage Manager™, DPT's award-winning setup and maintenance software.

Order a DPT PCI SCSI Adapter today and find out for yourself just how fast lightning really is.

**1-800-322-4378**

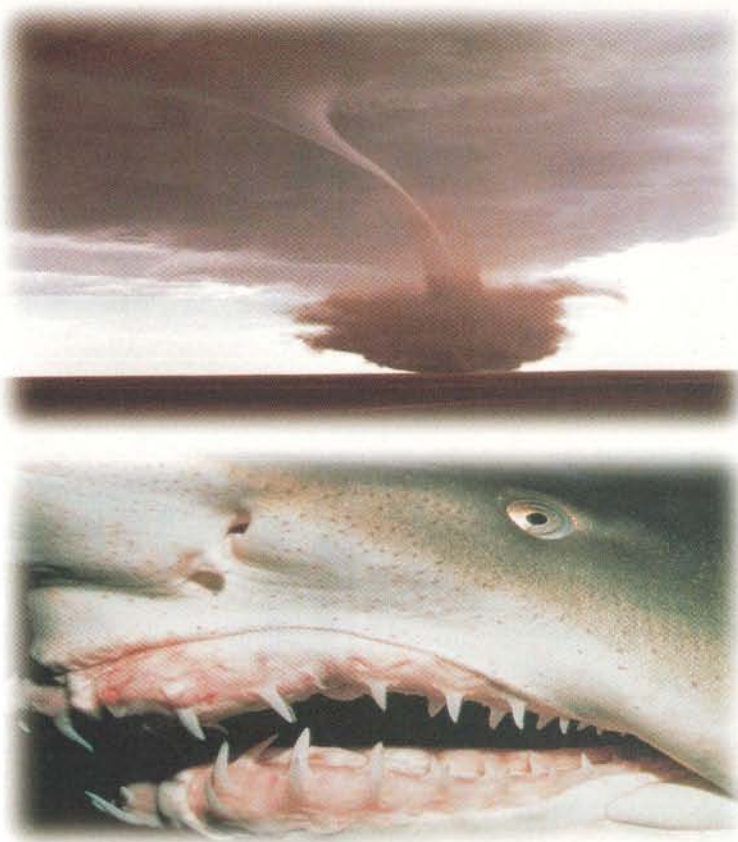
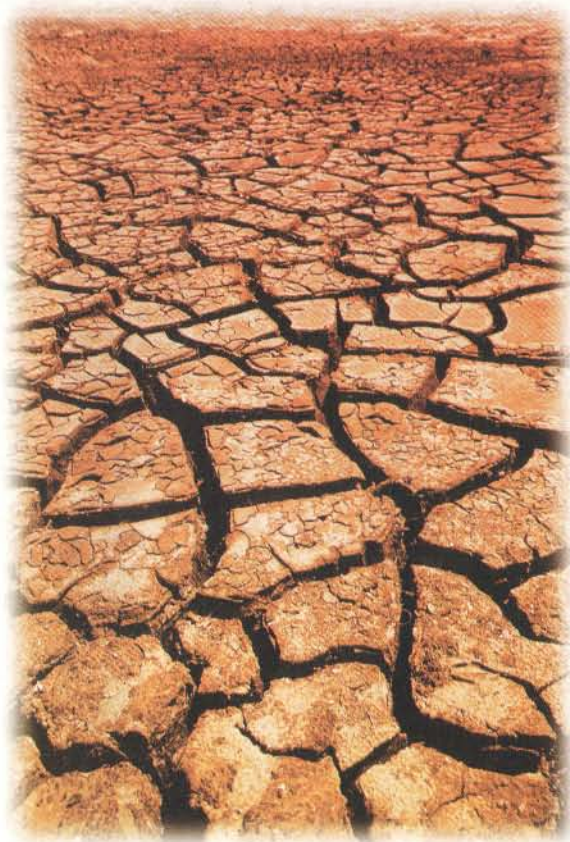
**DPT**  
Distributed Processing Technology

140 Candace Drive, Maitland, FL 32751





Our storage devices can endure long hours, natural disasters, and other forms of abuse.



[Not unlike a day at the office.]

The DE100™ is a removable disk/tape subsystem that allows you to easily remove, transfer, and store data. It's compatible with an extensive variety of standard SCSI or IDE/EIDE drives.

With room for three 1" SCSI disk or tape drives, the DS300 model is the most compact removable storage subsystem available on the market today.

The DS500™ is an external rack mount that houses nine half-height bays, allows users to integrate any SCSI peripheral combination, and includes up to two 300-watt power supplies.

An ideal storage chassis for workstations, network servers, and PCs, the DS100 provides flexibility for users to mix and match up to four SCSI peripherals.

When it comes to protecting valuable data, only Kingston's rugged storage devices have shown they can brave the elements. Though they were designed to perform in the most demanding commercial environments, they're also tough enough to survive in army bunkers, submarines, and even in spacecraft. Our Data Silo® enclosures and Data Express™ removables are constructed of rugged steel with a carefully designed and tested

ventilation system for cooling today's high-performance drives. Used in computer rooms, workstations, and network servers, they support more SCSI connections and have more options than any other storage subsystem on the market. If that doesn't impress you, our unbeatable five-year warranty will. So call Kingston or your nearest dealer for more information. Because in the world of storage systems, only the strong survive.



**Kingston**  
TECHNOLOGY CORPORATION

Call (800) 435-0670 or find us at <http://www.kingston.com>

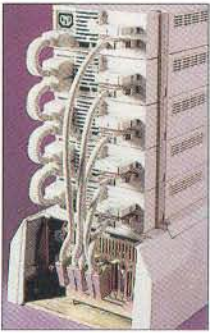
Kingston Technology Corporation, 17600 Newhope Street, Fountain Valley, CA 92708 USA, (714) 438-1850, Fax (714) 438-1847.  
© 1995 Kingston Technology Corporation. Kingston Technology is a registered trademark of Kingston Technology Corporation. All rights reserved.

Circle 72 on Inquiry Card (RESELLERS: 73).





# HONORABLE MENTIONS



**Artecon's** line of Lynx products offers what it calls "100 Percent Investment Protection." You can start with a single-drive storage unit, move up to a stacked, multidisk configuration by interlocking individual storage units, and then graduate to a RAID tower by keeping the existing drive storage units and adding a RAID controller subsystem.

**Raca-Lert for Windows** is an optional monitoring utility for the Storage Solutions Raca-Ray CM2+. Its graphical design makes it easy to detect a drive failure and begin the reconstruction procedure. With a modem connected to the Raca-Ray's second serial port, Raca-Lert can dial an emergency number to a tone pager, or it can dial a fax machine if a fax modem is attached.

## MORE ON THE RAID FRONT

We weren't able to test the following products, but they are worth mentioning:

Ciprico's 6900 Series of disk arrays are the first such products to use the UltraSCSI interface, which can transfer data at a maximum rate of 40 MBps. The 6900 Series was designed with film, video, and medical imaging applications in mind. The 6900 Series will be available in June. A nine-drive, 16-GB disk array costs \$39,575.

To better compete with lower-priced, single-controller RAID subsystems, Clariion began shipping its C150 single-controller product in July. The C150 costs \$10,995, which includes three 2-GB drives, 8 MB of cache memory, redundant power supplies and fans, and an interface kit for Sun, DEC Alpha, IBM, or Intel-based PC servers.

Hewlett-Packard is developing an adaptive RAID product called AutoRAID. The exact form AutoRAID will take is still under investigation. AutoRAID will dynamically adapt its algorithms to best suit the host system's data-use patterns. For example, newly written data that will probably have the most activity is stored using RAID 1 for better performance; as this data ages, it automatically migrates using RAID 5 for cost-effectiveness.

The Optima HST RAID Solution from Optima Technology is a RAID subsystem for NetWare and Unix applications. The Optima HST supports RAID 0, 1, and 5, up to 32 MB of cache, redundant hot-swappable drives and power supplies, a hot spare drive, and a SCSI-2 Fast/Wide host interface. It is available in configurations ranging from 6 to 115 GB.

Prices start at \$9995 for the 6-GB Optima HST 6000.

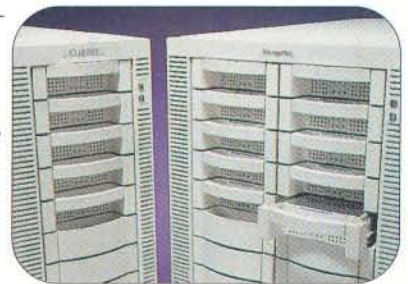
Xyratex, a former division of IBM located in the U.K., will begin shipping its R9000 subsystem in September. The Xyratex R9000 is a RAID subsystem for PC-compatible platforms running under a DOS, Windows, or NetWare environment. The enclosure has two integrated power supplies and fan units and supports up to seven drives. To expand it, you can add another tower for a total of 14 drives (56 GB). The R9000 supports RAID levels 0, 1, 3, and 5, and up to 64 MB of write cache. The R9000 is priced at £17,080.

**MicroNet Technology** offers a unique service to all its new RAID customers: the name and number of a technician who will walk you through the installation of your subsystem. No fumbling around with a user's manual or searching for the technical-support number.

## The Clariion C1300 and the StorageTek Nordique Open Storage Facility

offered the highest level of protection against data loss—

both include redundant drives, two power supplies, two fans, a second controller, and even a mirrored write-back cache. A copy of disk writes in cache is maintained on both controllers.



## ON THE LEVELS

**RAID 0:** Data is striped across drives; no data redundancy is provided.

**RAID 1:** Data redundancy is obtained by storing exact copies on mirrored pairs of drives.

**RAID 2:** Data is striped at the bit level; multiple error-correcting disks provide redundancy; not a commercially implemented RAID level.

**RAID 3:** Data is striped at the byte level, and one drive is set aside for parity information.

**RAID 4:** Data is striped in blocks, and one drive is set aside for parity information.

**RAID 5:** Data is striped in blocks, and parity information is rotated among all drives on the array.

## HELPFUL HINTS

- Remember to back up regularly. The RAID 5 configurations used here won't protect you in the unlikely event of more than one drive failing.
- If you do invest in a RAID subsystem, you should go through a "dry run" of a single-drive failure before bringing the subsystem on-line. That way, you'll know ahead of time how to handle this situation. Make sure rebuild instructions and your vendor's technical-support numbers are posted near the array.
- Consider configuring your array with drives from several different manufacturers to reduce the risk of multiple drive failures. (One reason the drive makers quote overly optimistic MTBF [mean time between failure] rates in a RAID environment is that the drives in an array are likely to be from the same assembly-line batch; thus, when one drive fails, the others, being of the same age and manufacture, are likely to fail at or near the same time).
- The cable and terminator pins in the SCSI-2 Fast/Wide interface bend easily. Take care when connecting and disconnecting these devices.
- Finally, don't forget to have a spare drive on hand.

**Ciprico, Inc.**  
Plymouth, MN  
(800) 727-4669  
(612) 551-4000  
fax: (612) 551-4002

**Clariion**  
Westboro, MA  
(508) 898-7600  
fax: (508) 898-7501

**Hewlett-Packard Co.**  
Santa Clara, CA  
(800) 752-0900  
fax: (800) 333-1917

**Optima Technology Corp.**  
Irvine, CA  
(714) 476-0515  
fax: (714) 476-0613

**Xyratex**  
Havant  
Hampshire, U.K.  
+44 1705 498851  
fax: +44 1705 498853



## ROLL CALL OF DISK ARRAYS TESTED

## FEATURES

MANUFACTURER	MODEL	PRICE AS TESTED <sup>1</sup>	PERFORMANCE		HOST ADAPTER AS TESTED	HARD DRIVE	MAX. NUMBER OF DRIVES
			SINGLE-THREAD RELATIVE AVERAGE/MAX. PERFORMANCE <sup>1</sup>	MULTITHREAD RELATIVE AVERAGE/MAX. PERFORMANCE <sup>3</sup>			
Artecon, Inc.	LynxTower LX-5000T RAID Subsystem	\$22,995	4.41/5.33	5.74/6.45	Adaptec AHA-2940W	Conner CFP2107S	7
Clarion Advanced Storage	C1300 Mirrored Cache Disk Array	\$35,391	4.45/4.02	4.58/6.66	NCR 8251D	Seagate Barracuda 32550N	10
Conner Storage Systems	CR12-RAID	\$16,593 <sup>2</sup>	5.27/4.12	4.73/7.79	Mylex DAC960P2 dual-channel	Conner CFP2107	12
Data Storage Marketing, Inc.	HSRAID-8	\$22,430	4.12/5.03	4.54/4.15	Adaptec AHA-2940W	Seagate Barracuda 32550N	7
<b>BYTE</b> Digital Equipment Corp.	StorageWorks RAID Array 230 Subsystem	\$12,183 <sup>2</sup>	8.76/5.78	9.06/5.85	Mylex Backplane RAID Controller with Digital firmware	StorageWorks 2.1-GB Wide SWXD3-WB	7
DPT, Inc.	SmartRAID Subsystem	\$12,615	3.96/1.23	2.51/6.3	DPT PM3224/W	Seagate ST12400N	6
Legacy Storage Systems, Inc.	SmartArray XE	\$20,957 <sup>2</sup>	5.31/4.92	4.47/6.90	Mylex DAC960P 3-channel with AEMI	Seagate Barracuda 32550W	12
Mega Drive Systems, Inc.	Enterprise E-8 PCI	\$11,900 <sup>2</sup>	8.41/6.79	5.28/4.66	Mylex DAC960PD dual-channel	Seagate ST12450W	14
MicroNet Technology, Inc.	RAIDbank Plus for PCI RBT2PCI/RPC	\$16,395 <sup>2</sup>	4.97/5.14	4.82/9.30	Mylex DAC960P2 dual-channel	Conner CFP2107E	6
Micropolis Corp.	RAIDION LTX 6.3 plus LM2100 Add-On Module	\$15,000	5.93/2.39	2.74/2.01	Adaptec AHA-2940W	Micropolis Model 4221	28
Perisot Technology	RaidSafe Plus 7 8MP	\$13,864	4.68/4.87	5.38/4.07	Adaptec AHA-2940W	Quantum XP32150AL-S	7
Procom Technology, Inc.	LANForce-5	\$10,255 <sup>2</sup>	3.88/5.46	3.85/2.44	Adaptec AHA-2940W	Seagate Barracuda 32550N	7
Raidtec Corp.	FlexArray FX	\$11,195	4.23/4.46	2.56/5.72	Adaptec AHA-2940W	Quantum XP32150	5
Storage Solutions, Inc.	Raca-Ray CM2+	\$13,595	5.91/6.25	9.66/6.85	Adaptec AHA-2940W	Seagate ST32550N	15
StorageTek Distributed Systems Division	Nordique Open Storage Facility	\$27,000	4.78/4.55	5.56/4.8	NCR 8251D	Seagate Barracuda ST12550N	20
Winchester Systems, Inc.	FlashDisk SCSI	\$19,737	6.64/5.57	6.79/5.74	Adaptec AHA-2940W	Seagate Barracuda 32550	8

## FEATURES CONTINUED

MANUFACTURER	MODEL	RECHARGEABLE BATTERY BACKUP	TYPES OF SECURITY	PLATFORMS SUPPORTED			OSes SUPPORTED		
				PC COMPATIBLE	MAC	POWERPC	DOS	WINDOWS 95	WINDOWS NT
Artecon, Inc.	LynxTower LX-5000T RAID Subsystem	○	D	●	●	●	●	●	●
Clarion Advanced Storage	C1300 Mirrored Cache Disk Array	●	N	●	○	○	●	●	●
Conner Storage Systems	CR12-RAID	○	E	●	○	○	●	○	●
Data Storage Marketing, Inc.	HSRAID-8	Optional	N	●	●	●	●	●	●
<b>BYTE</b> Digital Equipment Corp.	StorageWorks RAID Array 230 Subsystem	●	E	●	○	○	●	○	●
DPT, Inc.	SmartRAID Subsystem	○	E	●	●	●	●	●	●
Legacy Storage Systems, Inc.	SmartArray XE	Optional	E	●	●	●	●	●	●
Mega Drive Systems, Inc.	Enterprise E-8 PCI	●	E	●	●	●	●	●	●
MicroNet Technology, Inc.	RAIDbank Plus for PCI RBT2PCI/RPC	○	E	●	○	○	●	●	●
Micropolis Corp.	RAIDION LTX 6.3 plus LM2100 Add-On Module	○	N	●	●	●	●	●	○
Perisot Technology	RaidSafe Plus 7 8MP	●	E	●	●	●	●	●	●
Procom Technology, Inc.	LANForce-5	●	E	●	●	●	●	●	●
Raidtec Corp.	FlexArray FX	○	DE	●	●	●	●	●	●
Storage Solutions, Inc.	Raca-Ray CM2+	○	N	●	●	●	●	●	●
StorageTek Distributed Systems Division	Nordique Open Storage Facility	●	N	●	○	○	○	○	●
Winchester Systems, Inc.	FlashDisk SCSI	●	DE	●	●	●	●	●	●

**BYTE** = BYTE Best.

● = yes; ○ = no; N/A = not applicable.

<sup>1</sup> Price includes five drives with 2 GB each for a total capacity of 10 GB or approximately 8 GB with parity.<sup>2</sup> Price includes a sixth drive for a hot spare.<sup>3</sup> Maximum performance is based on the number of transactions completed per time unit. Higher numbers indicate better performance.<sup>4</sup> Total tested storage capacity excludes space for parity.



TESTED/MAX. TOTAL STORAGE CAPACITY (GB) <sup>4</sup>	RAID CONTROLLER	STANDARD RAID LEVELS SUPPORTED	RELIABILITY				TYPES OF ALARMS SUPPORTED
			REDUNDANT COMPONENTS	HOT-SWAPPABLE COMPONENTS	AUTOMATIC REBUILD SUPPORTED	HOT SPARE SUPPORTED	
8.4/28	CMD CRD-5000	0, 3, 5	DPF	DPF	●	●	VA
8/32	Clarion Proprietary	0, 1, 3, 5	DPFC	DPFC	●	●	VR
8/24	Mylex DAC960P2 dual-channel	0, 1, 5	DPF	DPF	●	●	VAR
8.4/12.6	CMD CRD-5000	0, 3, 5	DPF	DPF	●	●	VA
8.4/25.2	Mylex Backplane RAID Controller with Digital firmware	0, 1, 5	DPF	DPF	●	●	VR
8.4/26	DPT PM3224/W	0, 1, 5	DPF	DPF	●	●	VA
8.4/48	Mylex DAC960P 3-channel with AEMI	0, 1, 5	DPF	DP	●	●	VAR
10.5/30	Mylex DAC960PD dual-channel	0, 1, 5	DPF	DPF	●	●	VAR
8.4/24	Mylex DAC960P2 dual-channel	0, 1, 5	DPF	DP	●	●	VR
8.4/56.7	Micropolis GANDIVA	0, 1, 5	DPF	DPF	●	●	VA
8.4/12.6	CMD CRD-5000	0, 3, 5	DPFC	DP	●	●	VAR
8.4/24.8	CMD CRD-5000	0, 3, 5	DPFC	DPFC	●	●	VAR
8.4/22	Raidtec RUAC-II	0, 1, 3, 5	DPFC	DP	●	○	VAR
8.4/78	On-board Intel 960A RISC processor	0, 1, 3, 5	DPF	D	●	○	VAR
8.4/32	AMD 29000	0, 1, 3, 5	DPFC	DPFC	●	●	V
8.6/34.4	FlashDisk SCSI	0, 1, 3, 5	DPF	DPF	●	●	VAR

MAC OS	OS/2	NOVELL NETWARE 3.1X	NOVELL NETWARE 4.1X	UNIX	WARRANTY (YEARS/ COVERAGE)	TOLL-FREE PHONE	PHONE	ON-LINE ADDRESS	INQUIRY NUMBER
●	●	●	●	●	1/PLR	(800) 872-2783	(619) 931-5500	service@artecon.com	1396
○	●	●	●	●	3/P	(800) 672-7729	(508) 898-6775	http://www.dg.com	1397
○	●	●	●	○	5/P	(800) 724-3511	(407) 263-3500	raid.support@conner.com	1398
●	●	●	●	●	1/PL	(800) 543-6098	(303) 442-4747	N/A	1399
○	●	●	●	●	5/PLF	(800) 786-7967	(508) 841-7000	N/A	1400
●	●	●	●	●	3/PLFR	(800) 322-4378	(407) 830-5522	http://www.dpt.com	1401
●	●	●	●	●	5/PL	(800) 966-6442	(508) 681-8400	N/A	1402
●	●	●	●	●	2/PLF	(800) 404-6342	(310) 247-0006	labarta@uu1201.megadrive.com	1403
○	●	●	●	●	3/PL	(800) 800-3475	(714) 453-6100	MicroNet@aol.com	1404
○	○	○	○	●	5/PL	(800) 395-3748	(818) 709-3300	http://www.microp.com	1405
●	●	●	●	●	1/PL	(800) 447-8226	(408) 738-1311	sales@perisol.com	1406
●	●	●	●	●	1/PL	(800) 800-8600	(714) 852-1000 x 414	http://www.procom.com	1407
●	●	●	●	●	2/PLF	N/A	(404) 664-6066	raidtec@interramp.com	1408
●	●	●	●	●	3/PLF	(800) 745-5508	(203) 325-0035	info@ssi.mhs.compuserve.com	1409
○	○	●	●	●	2/PL	(800) 323-3289 x 2443	(708) 434-1200	http://www.storitek.com	1410
●	●	●	●	●	1/PL	(800) 325-3700	(617) 933-8500	info@winsys.com	1411

Components:  
D = drive  
P = power supply  
F = fan  
C = controller

Types of alarms:  
V = visual  
A = audible  
R = remote

Types of security:  
D = drives  
N = none  
E = enclosure

Warranty:  
P = parts  
L = labor  
F = freight to repair center  
R = return to customer



"I oversee a  
**\$24 million**  
budget and support  
**2400 users.**

Every month  
**BYTE**  
helps me  
evaluate  
products & technologies that keep  
**Lincoln National Life**  
a head of the  
technology/productivity  
curve."

Name: Skip Carstensen

Title: VP Product Administration Systems

Company: Lincoln National Life Insurance Company

Annual IT Budget: \$24 million

BYTE Reader: 9+ years



**B**YTE readers set the agenda for corporate Information Technology purchases. Their recommendations can take your products to the top – or leave them at the door. Why? Because BYTE readers are the *technology experts*. They define the short list. They specify brands. They tell the buyers what to buy.

Want to get your product in front of Skip? Advertise in BYTE. And reach more than a half-million technology experts who drive the IT buy.

**BYTE** Because the *Experts* Decide.

See for Yourself: To find out more about the buying power of BYTE readers, call 603-924-2618 and ask to see our *Information Technology Buying Process* video. BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



# Endian Issues

**By supporting two memory-addressing modes, the PowerPC can run any OS or application**

**WILLIAM STALLINGS**

One of the annoying but important differences among processors is the way they store data in memory. Most processors use one of two data-organization strategies, known as big-endian and little-endian, which are described in detail below. (The term *endian* is derived from a passage in Jonathan Swift's *Gulliver's Travels*.) Some machines, such as VAXes and systems based on the Intel x86 or the Pentium, are little-endian machines; others, such as the IBM System 370, machines based on the Motorola 680x0, and most RISC machines, are big-endian.

The differences between these strategies are relatively minor in terms of performance and efficiency. However, programmers and users alike need to be aware of endianness, because data ordered in one format isn't compatible with data ordered in the other. This isn't a problem when dissimilar platforms operate autonomously. But in a networked environment that encourages program portability and data interchange across platforms, this can create problems.

## Byte-Ordering

Endianness has to do with the byte-ordering of multibyte scalar values. The concept arises when it becomes necessary to treat a multiple-byte entity as a single data item with a single address, even though it's composed of smaller, addressable units. When a programmer assumes a specific endian format and attempts to manipulate the individual bytes or bits within a range of multibyte scalar values, problems can occur.

The following description of endian byte-ordering illustrates such a dilemma. Suppose you have the 32-bit hexadecimal value 12345678 stored as a 32-bit word in byte-addressable memory at byte location 184. The value consists of 4 bytes, with the least significant byte containing the value 78 and the most significant byte containing the value 12. There are two ways to store this value: Start with value 12 in location 184, or start with value 78 in location 184.

The first mapping stores the most significant byte in the lowest numeric byte address; this is known as *big-endian* format. The second mapping stores the least significant byte in the lowest numeric byte address; this is called *little-endian* format. For a given multibyte scalar value, big- and little-endian formats are byte-reversed mappings of each other. In any machine, data aggregates such as files, structures, and arrays are composed of mul-

tiples data units, each with endianness. Thus, the conversion of a memory block from one style of endianness to the other requires knowledge of the data structure.

The figure "Three Memory Orders of Structure K" illustrates how endianness determines addressing and byte order. The structure in the listing "A Multibyte C Data Structure" on page 264 contains several data types. The memory layout in part (a) of the figure results from compilation of that structure for a big-endian machine; part (b) shows the results from compilation for a little-endian machine. In each case, memory is treated as a series of 64-bit blocks.

Several observations about this data structure can be made:

- Each data item has the same address in both big- and little-endian schemes. For example, the address of the doubleword that has the hexadecimal value 545512134748BEBF is 08.

- Within any given multibyte scalar value, the ordering of bytes in the little-endian structure is the reverse of that for the big-endian structure.

- Endianness does not affect the ordering of data items within a structure. Thus, the four-character word  $\times 3$  in the listing exhibits byte reversal, but the seven-character byte array  $\times 4$  does not. Hence, the address of each individual element of  $\times 4$  is the same in both structures.

## PowerPC Addressing Modes

The PowerPC is a *bi-endian* processor; that is, it supports both big- and little-endian addressing modes. This bi-endian architecture enables software developers to choose either mode when migrating OSes and applications from other machines. The OS establishes the endian mode in

**Three Memory Orders of Structure K**

00	AA	00	AD	00	
	AB		AC		
	AC		AB		
	AD		AA		
04		04		04	AA
					AB
					AC
					AD
08	54	08	48	08	54
	55		47		55
	12		BF		12
	13		BE		13
0C	47	0C	13	0C	BE
	48		12		BF
	BE		55		47
	BF		54		48
10	13	10	43	10	E'
	12		22		W'
	22		12		O'
	43		13		P'
14	P'	14	P'	14	13
	O'		O'		12
	W'		W'		22
	E'		E'		43
18	R'	18	R'	18	
	P'		P'		06
	C'		C'		19
1C	06	1C	19	1C	C'
	19		06		P'
					R'
20	35	20	38	20	
	36		37		
	37		36		
	38		35		
24		24		24	35
					36
					37
					38

(a) Big-endian ordering of data.  
(b) Little-endian ordering as seen by a PowerPC processor (true little-endian ordering). (c) Little-endian ordering as found in PowerPC storage to minimize data swapping during memory accesses.



which processes execute; the default mode is big-endian. Once a mode is selected, all subsequent memory loads and stores are determined by the memory-addressing model of that mode.

To support this hardware feature, 2 bits in the MSR (machine state register) are maintained by the OS as part of the process state. One bit (ILE) specifies the endian mode in which the kernel runs when processing an interrupt; the other (LE) specifies the processor's current operating mode. Thus, the mode can be changed on a per-process basis, which is critically important for foreign OS emulation.

When an interrupt occurs, the processor saves the current MSR and loads an MSR for the interrupt-processing routine. The value of the ILE bit in the old MSR is copied into the LE bit in the new MSR. When execution resumes in the interrupted process, its MSR is reloaded with its LE and ILE bits intact.

## Byte Storage

The PowerPC architecture specification does not dictate how a processor should implement little-endian mode. It specifies only the view of memory that a processor has when operating in little-endian mode. When converting a data structure from big- to little-endian, the processor can either implement a true byte-swapping mechanism or use some sort of an address-modification mechanism. Current PowerPC processors are all big-endian by default and use address modification to treat data as little-endian.

Part (c) of the figure "Three Memory Orders of Structure K" shows how memory is laid out when data is stored in little-endian form for current PowerPCs. This is not a true little-endian organization as it is usually defined. Rather, it is designed to minimize the data manipulation required to convert from one endian format to another.

Note that 64-bit scalars are stored in the same formats on the PowerPC. To accommodate smaller scalars, a technique known as *address munging* is used. When the PowerPC is in little-endian mode, it transforms the 3 low-order bits of an effective address during a memory access. These 3 bits are XORed with a value that depends on the transfer size: 0x100 for 4-byte transfers, 0x110 for 2-byte transfers, and 0x111 for 1-byte transfers. The table "PowerPC Address Munging" below lists the possible combinations.

For example, the 2-byte value 0619 is stored at location 1C in big-endian mode. In little-endian mode, it's viewed by the processor as still being stored in location 1C, but in little-endian mode. In fact, the value is still stored in big-endian mode, but at

## A Multibyte C Data Structure

```
struct{
    int    x1;        //0xAAAB_ACAD                word
    int    pad;
    double x2;        //0x5455_1213_4748_BEBC        doubleword
    char*  x3;        //0x1312_2243                word
    char   x4[7];     //'P','O','W','E','R','P','C'    byte array
    short  x5;        //0x0619                    halfword
    int    x6;        //0x3536_3738                word
} k;
```

location 1A. When a transfer occurs, the system must do an address unmunging and a byte transfer to convert data to the form expected by the processor. The processor generates effective addresses of 1C and 1D for the 2 bytes. These addresses are munged (XOR with 110) to 1A and 1B. The data bytes are retrieved, swapped, and presented as if they were found in the unmunged addresses 1D and 1C.

## Unaligned Data

This address-munging technique does not work cleanly with data that is not aligned on its natural boundary (e.g., a 4-byte value is aligned if its address is divisible by 4). When a value is unaligned, its storage in little-endian mode might result in the value being split into two noncontiguous parts. When an unaligned access is attempted in little-endian mode, an alignment interrupt occurs. This causes the processor to transfer to the system-alignment error handler, which handles the interrupt by a series of load-and-store operations that emulate the memory access.

Because of the exception processing, accessing unaligned little-endian data can seriously degrade a processor's performance. The simplest fix is to properly align little-endian data. But this might not be possible for certain processes, such as an x86 emulator, which accesses variable-length x86 instructions in memory.

But another solution is in the works. New versions of the PowerPC 603 and 604 will handle misaligned little-endian accesses in hardware, and thus handle an alignment interrupt the same way as in big-endian mode. They will be able to operate in little-endian mode without incurring a performance penalty.

## Implications

The PowerPC architecture is organized for big-endian storage and processing. It also provides a transparent method for dealing with little-endian programs and data.

This enables a PowerPC processor to run a program written for little-endian memory organization simply by recompiling the application on the PowerPC, which reduces the program-porting work required. When the recompiled program is run on the PowerPC with the LE bit set, the processor's address-mapping facility makes all data structures appear identical to the layout that the program saw on a little-endian machine. This ability to handle bi-endian address modes makes the PowerPC processor ideal for hosting different OSes, such as on the CHRP (Common Hardware Reference Platform). ■

*William Stallings is an independent consultant. This article is based on material from his most recent book, Computer Organization and Architecture: Designing for Performance, Fourth Edition (Prentice-Hall, 1995). You can reach him on the Internet at [stallings@acm.org](mailto:stallings@acm.org) or on BIX c/o "editors."*

## POWERPC ADDRESS MUNGING

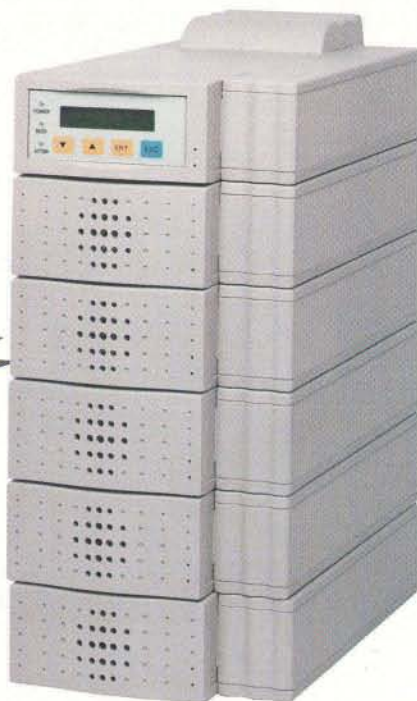
4-byte Transfers (XOR with 100)		2-byte Transfers (XOR with 110)		1-byte Transfers (XOR with 111)	
Original Address	Munged Address	Original Address	Munged Address	Original Address	Munged Address
000	100	000	110	000	111
001	101	001	111	001	110
010	110	010	100	010	101
011	111	011	101	011	100
100	000	100	010	100	011
101	001	101	011	101	010
110	010	110	000	110	001
111	011	111	001	111	000



# Imagine the First 3.5" System Independent SCSI RAID That Supports Dual Host Connectivity

## We Did!

Introducing  
**STACA-RAY™**  
4 TO 60 GB Capacity



Includes **RACA-LERT™**  
the Disk Array Monitoring/Alert Software

Actual Size: 14 1/2" (H) x 10 5/8" (D) x 6 5/8" (W)

## Data Availability and Reliability for Your Network or Desktop Computer... Has Never Been So Affordable!

SSI's *STACA-RAY* delivers the next generation of high performance RAID technology that provides dual host connectivity with a standby 'hot spare' drive at an affordable price. With 8 MB of cache memory which expands to 32 MB, and an optional Fast/Wide SCSI-2 interface, *STACA-RAY* provides the highest performance in it's class.

With the 3.5" form factor, open systems SCSI-to-SCSI RAID controller module, stackable 'hot swap' redundant components like disk drives, power supplies, power cords and fans... *STACA-RAY* provides all of the advantages of an expensive RAID subsystem at a low, entry-level price.

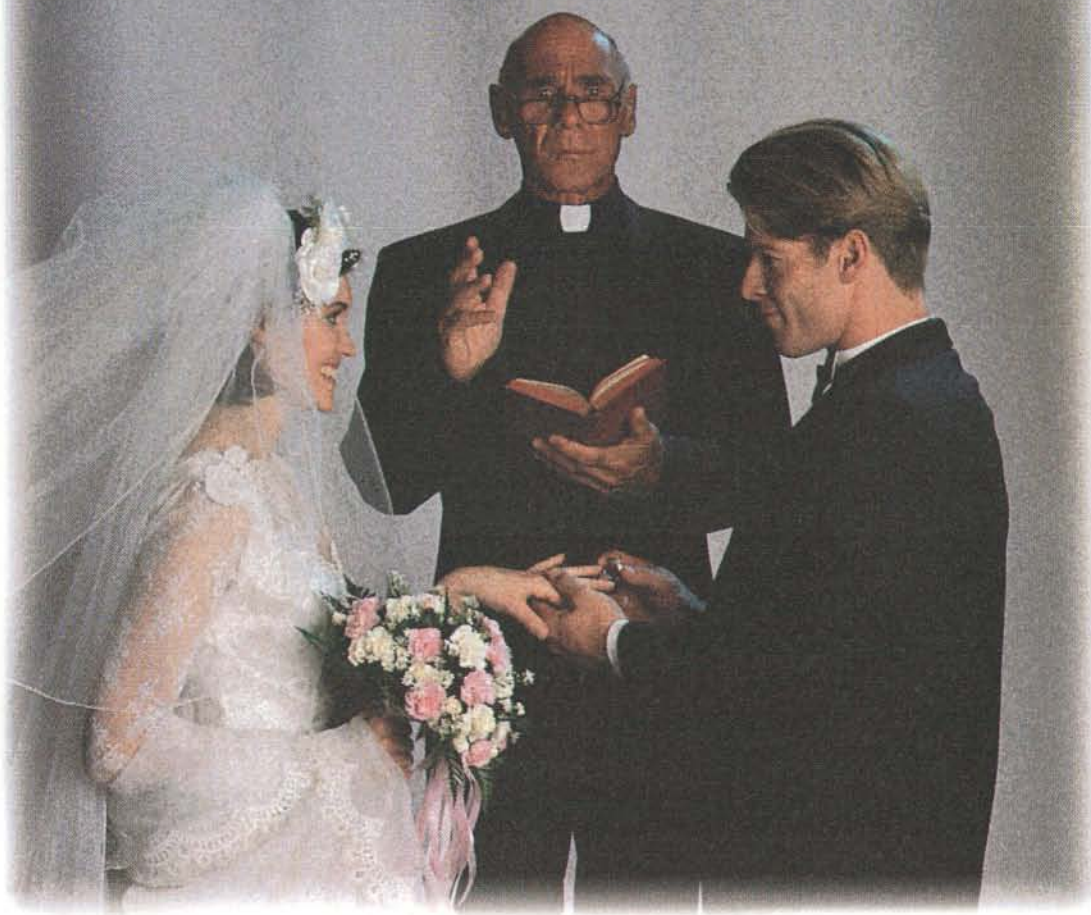
Call STORAGE SOLUTIONS for More Information  
on Truly Affordable RAID! **1-800-745-5508**



STORAGE SOLUTIONS, INC.  
550 West Avenue, Stamford, CT 06902



# Before you invest in the hardware, make sure you're compatible.



Buying computer products is a major commitment. A commitment of time and money. So before you jump in with both feet, make sure the relationship is going to work. Look for the NSTL Seal.

National Software Testing Laboratories puts hardware and software through the most rigorous testing in the industry. Our exclusive compatibility tests, using real world equipment like yours, ensure that components will talk to each other, work together, get along great — or they can't carry the Seal. And that's true for everything from drivers and servers, to applications, adapters and printers.



For more information about the NSTL Seal or a list of manufacturers who have earned it, call 800-220-NSTL or 610-941-9600. Before you walk down the aisle.



# The Joy Of J

**One line of J can do the same work as hundreds of lines of Pascal or BASIC**

**DICK POUNTAIN**

If you are involved in mathematical programming then you need to know about the J programming language. Even if you perform less abstract tasks like analyzing financial data from a corporate RDBMS (relational database management system), you will find J interesting.

J is the modern successor to APL, a language that developed a cult following among some corporate IBM mainframe users in the 1960s as a rapid and powerful (but cryptic) data processing tool. APL suffered from its use of an unorthodox character set (that included Greek characters, among others), which didn't sit well on ASCII text displays and keyboards.

J is a truly new language by APL's author, Kenneth E. Iverson, and implemented by his son Eric and colleague Ronald Hui. It's available on a wide range of platforms including DOS, Windows, OS/2, Unix, and Macintosh. J is more than just an ASCII-fied APL, but it retains the same fundamental principles. Ironically, Windows and the Mac could now support APL characters, but J sticks to ASCII characters—and is the better for it.

I've been using the Windows release of J version 2.05, which can be a powerful calculating engine for Visual Basic programs. The J system provides a DDE server which you can include in your VB (Visual Basic) programs, allowing you to do the math in J while writing the user-interface and file handling parts of your application in VB. J also comes with its own Windows-based development system so you can write stand-alone J programs that employ the Windows interface on their own account, including DDE, OLE, ODBC (Open Database Con-

nectivity), VBX (Visual Basic custom controls), and all the other trimmings.

J is an interpreted language, though this fact usually has little impact on J's processing speed. The language's primitive functions are written in C and are highly optimized. They will often run faster than the

obvious equivalents you might write yourself.

J employs a functional style in which expressions are evaluated from right to left. It does support dyadic operators (with both left and right arguments) such as + so that arithmetic looks quite familiar. There is only one data structure in J: the array. A number like 2 is treated as an array of rank 0, and text is an array of characters. You create new named objects simply by assigning them values (this includes programs). J allocates and frees memory automatically and invisibly, and the only limit on the size of an object is available memory.

## The Language

The syntax of J is extremely simple and regular; all functions have the same priority; parentheses are the only way to alter execution order. J's components are named using terms taken from English grammar:

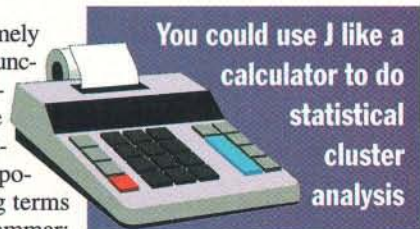
Functions are called verbs, constants are called nouns, adverbs and conjunctions modify the action of verbs. In fact, J is an executable mathematical notation, and Iverson has written a series of math textbooks, up to and including vector calculus, using J as the descriptive notation.

The J language consists largely of 70 or so verbs. Although J has abandoned APL's hieroglyphics, its verbs still have cryptic two-character names like >. or #: . Here is a one-line program to compute Hellerman's distance-squared similarity measure for a matrix of any size:

```
dsqt=. +/"1@*:@(-"1/~)
```

You could be forgiven for mistaking it for line-noise. To be fair, J doesn't have to look this scary; mean=. sum % count is a perfectly good J definition. The point is, someone fluent in J could hack dsqt from the keyboard during an interactive session, using J like a calculator to do statistical cluster analysis.

Math problems that would take hundreds of lines of Pascal or BASIC take one line of J. So, J is not a



## Numeric Integration

*A J program for performing numeric integration using Simpson's method.*

```
NB. form: verb simpson int
NB. verb is the monadic function to be integrated.
NB. int has 2 or 3 elements:
NB. [0] lower bound of interval
NB. [1] upper bound of interval
NB. [2] number of subintervals (default 128)
NB. result is the integral
NB. e.g. 43.75 = ^&3 simpson 3 4
simpson=: 2 : 0
('lower';'upper';'int')=. 3|.y..128
size=. (upper-lower)%int
val=. x. lower+size*i.>:int
size * +/val * 3%~ 1.((int-1)%4 2),1
)
```



language for the faint of heart. Learning the syntax and semantics of all the primitives will take time, but the reward is that you can then do extraordinarily intricate array and matrix computations that would be difficult or impossible in, say, a spreadsheet.

Most of the verbs either generate arrays or perform operations on elements of arrays. You can combine primitive operations by using adverbs to form new operations. For example, `i. 89` generates a list of the integers up to 89, and `+` is the humble sum operation. The adverb `/`—called “insert”—causes its left argument to be inserted between the elements of its right argument. So `+/ x` means sum the whole list `x`, and hence `+/ i. 89` sums all the integers up to 89. Or again, the adverb “tie” is represented by `^`. Its action is to combine several verbs into one (called a gerund). The gerund `+*^`—when applied to `1 2 3 4` will calculate `1+2*3-4`. If you need to use such constructs more than once, you can give them a name, as in

```
ger=. +*^-
```

where `=.` is just the assignment operator. To save names permanently, you store the text into script files, which when loaded execute as though typed from the keyboard.

Unlike APL, J supports conventional control structures like `if...then` and `while`. You could define `factorial` as:

```
factorial=. 3 : 0
a=. 1
while. y. > 1
do. a=. a*y.
   y=. y. - 1
end. a
)
```

(where `y.` refers to the verb's right argument), though a hardened J-bird would probably prefer the cryptic definition:

```
factorial=. 1:~([*factorial@<:)) @. *
```

Actually it's pointless to do either, as `factorial` is a built-in primitive verb, `!`.

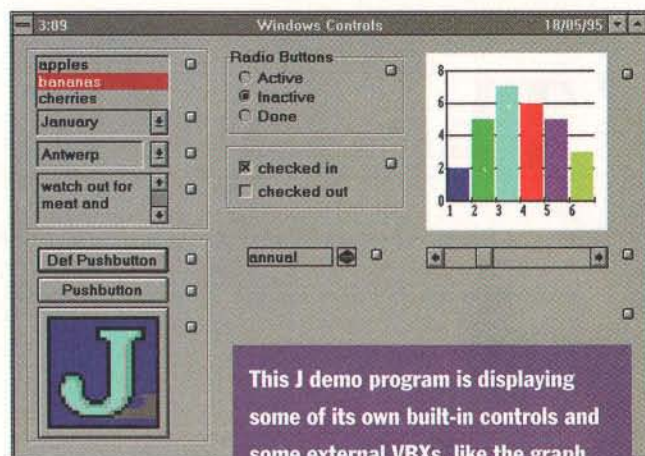
Another J innovation is the concept of a “locale,” or private name space, so that `mydef` defined in locale A is different to `mydef` in locale B. Locales enable you to write modular applications while avoiding name clashes.

Finally, an important (if rather unaesthetic) feature of J is the “foreign conjunction” which is the way you do system dependent, nonmathematical things. The conjunction `!:` takes two numbers as left and right arguments to produce a verb which is a system call. For example, `1!:0` is the directory call, so `1!:0 '*.*txt'` will list all the text files in the current directory. This construct compounds J's unreadability, though a diligent programmer can always write a library of meaningful synonyms.

## Windows and J

You can write J programs that fully exploit the Windows graphical interface (or the Mac, or OS/2, and so forth) by using verbs called `wd` commands (actually, `wd` is a friendlier synonym for `1!:0`). For example,

```
wd 'mb "Dick says" "Hello!" ;'
```



pops up a Windows

message-box with title “Dick says” and content “Hello.” J's interpreted nature doesn't mean that windowing operations are slow. As with VB, when a window is open it's mostly Windows GDI (Graphical Device Interface) code being executed.

J's Windows driver provides 10 control classes: button, edit, listbox, combobox, scrollbar, static text, isigraph, isipicture, isiole, and vb. Isigraph is a graphics box, and J contains many graphics commands (e.g., `gpolygon`) to draw in it, while isiole is the graphical presentation of an embedded OLE object. The `vb` control class allows you to add VBX controls into J programs. J can drive other windows applications via DDE links and OLE 1 linking and embedding, but it does not yet support OLE 2.

J's `vedit` verb lets you visually edit any parent window and its controls (i.e., by dragging with the mouse), and J's publishers have used it to good effect in writing a simple but effective forms editor supplied with J. The editor lets you build an application by choosing controls from a menu, like a mini-VB.

Though J's Windows interface is powerful and well thought out, it's still easier to write complicated user interfaces using VB, and J lets you do just that. Including `JDDE.FRM` and `JDDE.BAS` in your VB project gives you a DDE link to a J server, along with an attendant API. For example, the VB routine `jdo($$)` executes its string argument as an expression in J, while a variety of data exchange routines will retrieve values from J and format J-style arrays in VB-style arrays. You can even make an executable version of your VB application that includes a J run-time server.

Finally, J is a powerful tool for manipulating numeric data held as tables in a corporate relational database. A `ddsql` verb lets you execute SQL statements directly from J code.

## The Way of J

J is not a programming language that everyone will take to, but it will prove interesting and useful to more than just those confined to mathematics departments. Programmers working in such business sectors as insurance, banking, derivatives trading, and planning need precisely the combination of ultrasophisticated math functionality, database connectivity, and a Windows interface that J so capably provides. ■

*Dick Pountain is a BYTE contributing editor based in London, U.K. You can reach him on the Internet or BIX at [dickp@bix.com](mailto:dickp@bix.com).*

Where  
to Find

Strand Software, Inc.  
Shorewood, MN  
(612) 470-7345  
fax: (612) 470-9202  
[amfaust@aol.com](mailto:amfaust@aol.com)



# The 1995 Chili for Children Cook-Off is missing a key ingredient: **YOU!**

Thanks again to all our 1994 Chili for Children Cook-Off sponsors. It was the hottest cook-off yet, as your support helped raise over \$500,000 for missing children. This year's event promises to be another great time for all, and while the Cook-Off is the largest event of Fall Comdex, it's sure to sell out. Reserve your sponsorship now and help make the 1995 Chili for Children Cook-Off the best ever. Call Kate Potts at Micrografx, (214) 994-6413, for details.



Corporate sponsorships start at \$3,500.

**MICROGRAFX®**  
Proud Patron of the Chili for Children Cook-Off

1994 CATTLE BARON SPONSORS

Borland

CLARIS®



IBM

IDG  
INTERNATIONAL DATA GROUP

Inc.  
MAGAZINE

INGRAM  
MICRO

intel®

THE  
INTERFACE  
GROUP

Intuit®

Lotus  
Working Together

MICROGRAFX® Microsoft

mips/SiliconGraphics  
Computer Systems

PICTURETEL

Tektronix

TEXAS  
INSTRUMENTS

XEROX

ZD Ziff-Davis Publishing



# More than just a computer network.

## Technology Experts



## Corporate Management



## Strategic Network Decision-makers



## Enterprise Network Integrators



## IS/IT and the Channel



## McGraw-Hill Publications. MAXIMIZE YOUR REACH.



- 4-Architectural Record
- 7-A/C Flyer, Aviation Week & Space Technology, AW & ST Russia, Business & Commercial Aviation, World Aviation Directory, Buyer's Guide, World Aviation Catalog Guide
- 20-Business Week, Business Week China, Business Week Poland, Business Week International Edition, Business Week Russia
- 28-Chemical Engineering
- 32C-BYTE, Data Communications, Data Communications International, LAN Times, Open Computing
- 39-Electrical World
- 41-ENR, Construction News Publishing Network (14 Magazines, 5 Newspapers), Sweet's Catalog File
- 46-Global Finance
- H6-The Physician & Sportsmedicine, Postgraduate Medicine
- 114-Modern Plastics, Modern Plastics International, Modern Plastics Encyclopedia & Buyer's Guide
- 117-Power, Electric Power International



# Springtime at Sun

**SunSoft's experimental OS contains clues to the future of Solaris**

**DOUG TAMASANIS**

**O**n March 21, the first day of spring, SunSoft released to the research community a "concept car" for the next generation of OSes. Called, naturally enough, Spring, it is the fruit of labor begun in the mid-1980s. The company decided to produce a new OS, unconstrained by the requirement to support legacy software, that was distributed, multithreaded, and fully object-oriented.

Although Spring will not be the next version of Solaris, many of the concepts found in Spring will eventually migrate to SunSoft's commercial OS. Technology developed for Spring is the foundation for Sun's DOE (Distributed Objects Everywhere). Pieces of Spring have also found their way into the object technology being developed by the OMG (Object Management Group).

## Defining Interfaces

A Spring object is an abstraction containing a state and a set of methods to manipulate that state. SunSoft calls the description of the object and its methods an interface. This interface defines interactions between an object providing a service (i.e., a server) and an object using the service (i.e., a client).

To maintain openness and not tie developers into a single programming language, SunSoft developed an IDL (interface definition language) to define the interfaces. An IDL compiler converts IDL into three pieces of code in the chosen target implementation language: the IDL interface, client-side stub code, and server-side stub code (see the figure "Spring IDL").

The IDL interface is language-specific. In C, for example, this is a header file with method definitions, constants, and types defined in the IDL interface. Client-side stub code is dynamically linked to a client's program, allowing access to an object implemented in another address space or on another machine. Server-side stub code is linked into an object manager to translate incoming remote object invocations into the run-time environment of the object's implementation.

These three pieces of code enable objects in a particular language to treat IDL-defined objects as if they were native-language objects. Thus, if your client object were in C++, you would use an IDL-to-C++ compiler to produce C++-compatible header files and stub-code objects. If a server object's implementation is in C, you would have to use an IDL-to-C compiler to generate the server-side stub code to transform incoming calls into corresponding C procedure invocations on the C objects cor-

responding to the IDL objects. Spring's IDL forms the basis of the IDL adopted by the OMG.

## Invoking Objects

All Spring interfaces are defined in IDL, yet IDL doesn't define anything about how to implement operations on an object or how to convey operation requests to an object. To use an object, you merely invoke operations defined in its interface. The client and server object don't need to know if the object on the other side of the interface is in the same address space, in another address space on the same machine, or on another machine.

The IDL-generated stubs use Spring's subcontract mechanism to communicate. Subcontracts provide a flexible way to control the implementation of object invocations, the transmission of object references between address spaces, the release of object references, and similar object run-time operations. Other uses include the implementation of a number of object run-time mechanisms.

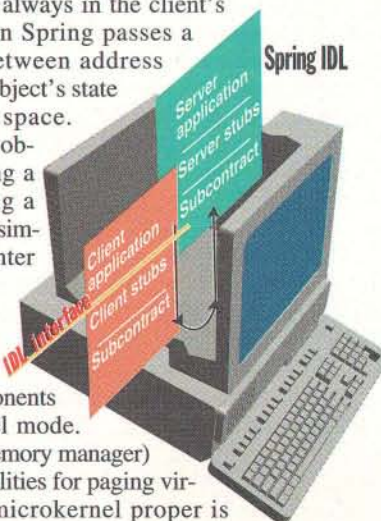
Server-based objects typically use the Spring doors mechanism to communicate between client and server (see the figure "Spring Doors" on page 272). Most subcontracts optimize the case when the client and the server are in the same address space by performing a local call rather than calling through the kernel.

Spring also supports serverless objects, where the entire state of the object is always in the client's address space. When Spring passes a serverless object between address spaces, it copies the object's state to the new address space. Passing a serverless object is akin to passing a struct, while passing a server-based object is similar to passing a pointer to its remote state.

## Spring Kernel

Spring's microkernel IDL design has two components that run in the kernel mode. The VMM (virtual memory manager) provides the code facilities for paging virtual memory. The microkernel proper is called the nucleus.

The nucleus supports three abstractions: domains, threads, and doors. Domains are analogous to processes in Unix. Threads execute within domains. Typically, each Spring domain is multithreaded, with separate threads performing different parts of an application. Doors support object-oriented calls between domains. A door describes a particular entry point to a domain, represented by both a program counter and a unique value that is chosen by the





domain. The object server typically uses this value to identify the state of the object.

Each domain has an associated table of doors to which it has access. Multiple door identifiers in different domains may reference a single door. Possession of a valid door gives the processor the right to send an invocation request to that door. In the target domain, all invocations on a given door are equivalent, specifying only that the invoker has somehow acquired a suitable door identifier. There is no knowledge of who the invoker is or which door identifier it used.

Spring uses network proxies to extend the nucleus invocation mechanism and transparently connect the nuclei of different machines. These proxies are normal user-mode server domains and receive no special support from the nucleus. One Spring machine can include several proxy domains that speak different network protocols.

Proxies transparently forward door invocations between domains of different machines. When a client on machine B invokes door Y, machine B forwards the call over the network to proxy A. Proxy A does the door invocation, and the door invocation arrives in the server domain. Neither the client nor the server need be aware that proxies exist. The client just performs a normal door invocation, and the server just sees a normal incoming door invocation. Spring maps door identifiers into network handles for transmission over the network and remaps back to the door when the door identifiers arrive from the network. A network handle contains a network address for the creating proxy and a set of bits to identify a particular door that is exported by this proxy.

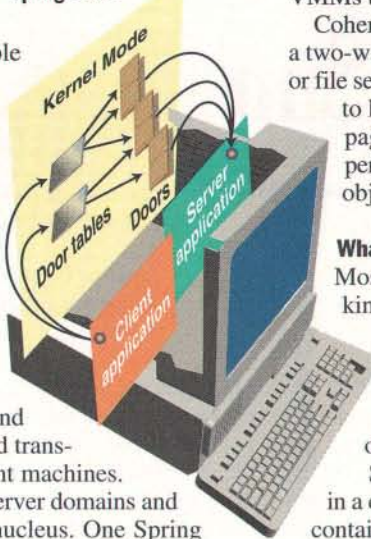
Spring implements an extensible, demand-paged virtual memory system that separates caching pages from the tasks of storing and retrieving pages. A per-machine VMM handles mapping, sharing, protecting, transferring, and caching of local memory.

Most clients of the virtual memory system deal only with address space and memory objects. An address-space object represents the virtual address space of a domain. A memory object is a memory abstraction mapped into address spaces, such as a file object. The VMM implements address-space objects.

A memory object has operations to set and query the length, and to bind to an object. Binding ensures that two equivalent mapped memory objects will share the data cached by the VMM. There are no page-in/page-out or read/write operations on memory objects. The Spring file interface provides file read/write operations but not page-in/page-out operations. By separating the memory abstraction from the interface providing the paging operations, the memory-object server and the pager-object server can be in different machines.

The VMM obtains data by invoking a pager object implemented by an external pager. An external pager performs coherency actions by invoking a cache object implemented by a VMM. When a pager asks a VMM to map a memory object into an address space, the VMM must be able to obtain a pager object to let it manipulate the object's data. Association between the pager and a cache object is necessary to ensure coherency. Typically, there are multiple pager-cache object channels between a given pager and a VMM. The external pager implementing the

## Spring Doors



memory object maintains data coherency between different VMMs that are caching a memory object.

Coherently caching data using more than one VMM requires a two-way connection between the VMM and an external pager or file server. The VMM needs a connection to the external pager to let the VMM obtain and write out data, and the external pager needs a connection to the VMM to let the provider perform coherency actions. Spring employs pager and cache objects to represent these connections.

## What's in a Name?

Most OSes have several name services tailored for specific kinds of objects (e.g., files, users, and printers). Spring provides a uniform naming service allowing any object to be bound to any name. Use of a common name service eliminates construction of name spaces by all object implementations. But remember that Spring is completely object-oriented, so it can support multiple name servers. Spring allows association of objects with a name that is in a context or name binding. Contexts are themselves objects, containing name-to-object associations that clients use to perform naming operations. Objects can be concurrently bound to different names in different contexts or not bound to any name. By binding contexts in other contexts, Spring creates a naming graph. This is a directed graph with nodes and labeled edges, where the nodes with outgoing edges are contexts.

Unlike naming in traditional systems, Spring contexts and name spaces are first-class objects. That is, you can directly access and manipulate them. Also, Spring objects derive persistence through naming. Generally, applications will acquire their objects from the name service. If the region of the name space where the object is found is persistent, the object will also be persistent.

## Spring Is Not Unix

Spring is not Unix, but it does provide binary compatibility for a number of Solaris programs by using a Unix-emulation subsystem. The emulation runs as user-level code and employs no Unix code. The implementation consists of two components: a shared library dynamically linked with each Solaris binary and a set of Unix-specific services exported via Spring objects implemented by a Unix process server in a separate domain.

The Unix process server implements functions that are not part of the base Spring system and which cannot reside in the shared library due to security reasons. The system provides enough Unix emulation to support standard utilities, such as `make`, `vi`, `csh`, X Window System, and various Solaris programming tools used by the Spring developers.

Running Unix in emulation would clearly be unacceptable in production environments, which is why SunSoft wants it known that it does not intend to make Spring the next version of Solaris. The company has learned its lesson from the porting effort that got it to Solaris. However, Spring demonstrates just what you can do if given the chance to build a sparkling-new OS with modern software engineering methods, without worrying about legacy systems. ■

*Doug Tamassanis is a BYTE senior technical editor. He holds an M.S. in physics and systems engineering and is a senior member of the IEEE. You can reach him on the Internet or BIX at editors@bix.com.*

Obtaining  
a Copy

**Spring Research Distribution**  
University/public researchers: \$75  
Commercial researchers: \$750  
(800) 786-7638



# Tuning In to ISDN

**Wireless transmission methods help speed**

## ISDN deployment

**JEFFREY FRITZ**

**D**ick Tracy's famous wrist radio was way ahead of its time as a portable communications device. It allowed Tracy to be anywhere in the city and still stay in contact with the people and resources he needed to do his job. By contrast, digital telecommunications services are anything but portable. Most are lashed by twisted pair to wall-mounted faceplates. The lack of portability reduces flexibility and restricts access. It also creates dependency on outside agencies, like the telephone carriers, to provide service to the faceplate.

As with most digital services, ISDN has been a tethered service requiring physical connections to the fiber- and copper-based telephone network. Considering the wide range of voice, video, and data applications it supports, ISDN's lack of mobility has been extremely constraining. Fortunately, a new form of ISDN, called ISDN Radio, is breaking the copper umbilical cord and offering users unhindered communications freedom.

ISDN Radio comes in two flavors: satellite and radio (see the figure "ISDN Radio/Satellite Configurations" below). Satellite ISDN is based on VSAT (Very Small Aperture Terminal) technology. VSAT uses transportable satellite link equipment and relatively small uplink/downlink dishes. Connections are made using leased or call-based satellite channels. Radio ISDN uses specialized modems called spread-spectrum modems which distribute the signal over a wide bandwidth, reducing interference and improving security. While satellite ISDN can span continents, radio ISDN's range is limited. It is broadcast primarily via transmitters operating on 1 W or less. The low power restricts the range, depending on antenna height and terrain, to a maximum radius of 30 miles.

### Quickness Counts

Among ISDN's biggest drawbacks are long installation time, distance limitations, and a lack of ubiquity. ISDN Radio can help resolve each of these flaws. While terrestrial ISDN orders

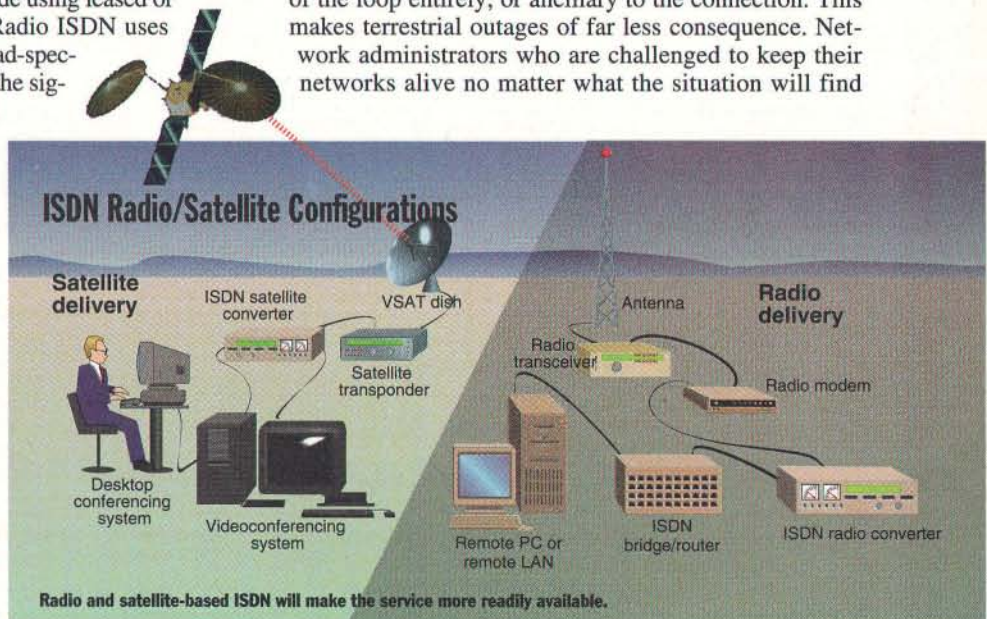
take days or even weeks to process, ISDN Radio equipment can be set up quickly. It's not unusual to have service in place within 24 hours. This makes ISDN Radio especially valuable when unexpected events take place, such as a network outage, an urgent site coming on-line, a network demonstration that was scheduled without advance notice, or a last-minute video conference.

It's also possible to have ISDN Radio service in locations where terrestrial ISDN is not available. Where there is no terrestrial ISDN, ISDN Radio can step in as an extension service. ISDN Radio's transportability can bring ISDN to a non-ISDN location. It can also extend ISDN past the infamous "last mile," which occurs when ISDN is available locally, but the remote site exceeds the 18,000-foot distance from the central office.

That's where ISDN service delivered over a satellite link can help. "Satellites can seamlessly extend ISDN from any ISDN public network to remote locations that do not have access to ISDN terrestrially," says Thomas von Deak of NASA's Lewis Research Center. "This is important because ISDN will form the basis for the first implementation of the NII [National Information Infrastructure] and the GII [Global Information Infrastructure]."

### Reaping Other Benefits

ISDN Radio adds more than basic network connectivity. By nature, ISDN Radio is redundant. Connections are not made over the terrestrial telephone network, but through radio or satellite. The local telephone company is either out of the loop entirely, or ancillary to the connection. This makes terrestrial outages of far less consequence. Network administrators who are challenged to keep their networks alive no matter what the situation will find





ISDN Radio particularly attractive. Should a disaster such as earthquake, fire, flood or tornado disrupt terrestrial-based WAN connections, the network manager can call on an ISDN Radio provider to quickly restore services. The company may also choose to have ISDN Radio in hot standby, or even in active service. When the terrestrial connections go down, the ISDN radio links can be pressed into service.

Broadcasters realize that ISDN can provide enhanced audio quality without the need for multiple analog lines or audio frequency shifting equipment. A single BRI (Basic Rate Interface) line without compression can provide 7.5-kHz bandwidth audio. For comparison purposes, 7.5 kHz is equivalent in quality to a decent AM station. Increasing audio bandwidth to 15 kHz, comparable to FM quality, or adding stereo can be achieved with multiple ISDN lines or compression. This makes ISDN ideal for remote broadcasts that sound as if they originated in the studio.

### Points to Ponder

ISDN Radio is not without its disadvantages. It requires extra equipment, some of which is fairly expensive. It takes special know-how to set up, operate, and maintain the service. Satellite time can be expensive, and satellite channels require access to a satellite provider. ISDN Radio is subject to the same limitations as any radio service. Interference and poor signal quality can cause problems. Most importantly, satellite delays adversely affect the quality of ISDN Radio's service.

Satellite links introduce a fair amount of delay (see "When Timing's Critical" above). If severe enough, delays can garble voice transmissions, scramble video, and collapse WAN connections. For example, a terrestrial ISDN BRI (Basic Rate Interface) delays the signal about 10 milliseconds. An international terrestrial circuit experiences delays of 140 ms. A single satellite hop has a marginal range one-way delay of 260 ms. Bidirectionally, satellite delays can be well over 500 ms. This puts satellite delays in the unacceptable range for some applications.

Delays can cause problems for isochronous applications that require audio and video synchronization, or are intolerant of disruptions in information flow. Delays can also cause problems for network applications. If the delay is long enough, the network protocol may assume that the communications link has been lost and time out the session. Even a less drastic network response to delays can cause unnecessary retransmissions, collisions and, in severe cases, broadcast storms. Users considering ISDN Radio for network or time-sensitive applications should take steps to make sure that the technology will work for them.

### What the Future Holds

One of the more interesting demonstrations of ISDN Radio technology is NASA's ACTS (Advanced Communications Technology Satellite), which the Space Shuttle Discovery launched on September 12, 1993. The NASA Lewis Research Center in Cleveland, Ohio, manages the satellite; it is a test of digital communications that span the spectrum when it comes to ISDN satellite applications. ACTS provides single hop mesh ISDN that attempts to integrate seamlessly with terrestrial networks. No attempt is being made to use specially modified equipment for the tests. Off-the-shelf ISDN equipment is currently being tested over the ACTS and used in demonstrations to the public. Interestingly, NASA has cross connected ACTS and terrestrial ISDN circuits through a traffic terminal in Cleveland. This allows access to the ACTS system from anywhere an ISDN connection is available.

The large number of companies, universities, and research

### WHEN TIMING'S CRITICAL

Signal delays pose problems for isochronous applications.

Service	Delay (ms)	Quality of Service
National T-1 Service	1	Acceptable
Terrestrial ISDN	10	Acceptable
National analog service	25	Acceptable
International terrestrial service	140	Acceptable
Single hop satellite	260	Marginal
Bidirectional satellite	520	Unacceptable

organizations that use ACTS includes Comsat, the U.S. Army Research Labs, the National Telecommunications and Information Administration, and NIST (National Institute of Standards and Technology). There are several interesting technology examples being tested on ACTS. In one experiment, Corporate Computer Systems, JPL (Jet Propulsion Labs), and CBS Radio are demonstrating ISDN high-quality audio transmissions. The North American ISDN Users' Forum has been testing a PC-based multimedia teleconferencing system over a VSAT-transportable link back to the Lewis Research Center, the JPL, and other sites.

One particularly interesting application is a disaster-recovery and communications-augmentation experiment. Ohio University conducted tests to help Huntington Bank recover from a simulated disaster that created a total loss of communications. ACTS was used to transmit financial data such as deposits, account balances, and transfers of funds. The experiment measured the ability to switch over to a backup communications system within an acceptable period of time as well as the economical advantages of using ISDN satellite as a backup system.

Bellcore is conducting experimentation with satellite-based PCS (Personal Communications Services). The goal of this research effort is to demonstrate a satellites' capabilities for enhancing ground-based personal communications voice and data services. The experiment will determine the ways in which local exchange network providers can interface to wireless service providers and the kinds of services that should be offered.

Finally NIST has connected the ACTS ISDN system to the government's FTS2000 digital communications infrastructure and is investigating interoperability issues between the terrestrial and satellite systems.

Given encouraging results from ACTS and early user successes, ISDN Radio appears worthy of consideration as a vehicle to provide redundant network backup, remote WAN connections, broadcast remotes, or world-wide videoconferencing. If your local service provider gives you a blank stare when you ask for ISDN connections, ISDN Radio could be your answer.

Clearly, ISDN is getting more interesting by the moment. No longer tethered by copper umbilical cords, the freedom to have digital voice, data, and video services at any time and any place is truly exciting. Dick Tracy would have been very much at home with ISDN Radio. ■

*Jeffrey Fritz is a telecommunications engineer responsible for the design and management of data communications for West Virginia University, including its ISDN applications lab. He is the chair of the North American ISDN Users' Forum Enterprise Network Data Interconnectivity Family. Mr. Fritz also chairs the National Information Infrastructure Working Group. He is the author of Sensible ISDN Data Networks (WVU Press, 1992). You can contact him on the Internet at jfritz@wvnm.wvnet.edu or on BIX at editors@bix.com.*



JERRY POURNELLE

# Of COM Ports and Digital Frogs

**I**t has been a busy month. First off, I was the keynote speaker at the Association for Media and Technology in Education in Canada, which met this year at the University of Guelph. The city of Guelph is about an hour from Toronto, just far enough that it hasn't lost the feel of a university town in a rural setting; it reminded me of Iowa City in the 1950s. AMTEC is one of the older organizations promoting technology in education.

A major issue in education technology is distance learning. Studies by the Danish Ministry of Education conclude that the critical cost factor is how to make low-paid people—such as students—do the work formerly done by high-paid people. Danish and other studies also indicate that the general result of applying high technology to education is to increase educational quality, but at increased costs; it's rare when high-tech education saves money. That's a big disappointment in this era of falling education budgets.

Guelph is the major center of Canadian veterinary education. Lifelearn V., a private company in a joint venture with the university, has developed one way to both increase education quality and save money. They've got the first really practical applications for CD-I (CD Interactive) I've seen.

Lifelearn uses CD-I for multiple reasons. First, it's easy to use, and it requires no computer experience. Second, they can give away the CD-I box, which outputs NTSC video into a TV set, as part of the course. Finally, since many parts of the course materials feature real-time demonstrations, they want interactive full-motion video, which CD-I supplies nicely.

Continuing education is important in many professions. Sometimes it does some good, but, alas, all too often continuing education workshops degenerate into a series of Mickey Mouse sessions at which you get your ticket punched while vacationing on Maui or a Phoenix golf course. Some of those refresher workshops may be valuable, but Lifelearn offers an alternative. For less money, you can get the Interactive Multimedia Self-Study Modules prepared by vet-

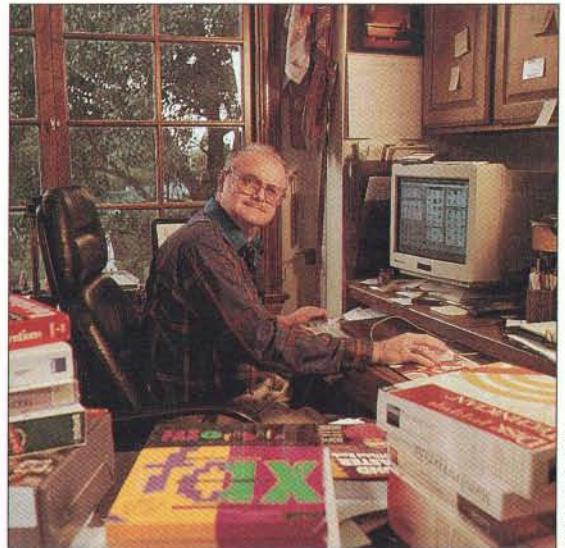
erinary experts accredited in both Canada and the U.S. Because it's on CD-I and audiotape, everyone in the clinic can take the machine home and go through the course materials. Course content varies from canine dental surgery through cardiology to dairy farm health management.

The Lifelearn CD-I system impressed me a lot. I'm certain that soon enough this kind of thing will be available—from one source or another—for dozens of professions. Meanwhile, if you're a veterinarian, you should know about the Interactive Multimedia Self-Study Modules.

**Of course, there's an awful lot of pure hype about educational software.** One (very badly produced) video I have spends half an hour telling about its problem-solving approach to education. Principals wax eloquent on how this launches high school students into lifetime learning. Other teachers tell us that the kids just love this stuff because it's not a boring book. Then we're informed that "problem solving is a very unique process." You can re-create electronically just what the student did to solve the problem.

What they're selling is authoring materials.

*continued*



AMY ETTRA © 1995

**Jerry attends an education conference and then learns a thing or two about communications software in Windows 95**



# American Made Steel Chassis

## Computer or RAID Applications



- Rugged all-steel construction
- Designed for FCC certification
- Easy assembly and service
- Full line of models and sizes
- Competitive prices
- American made redundant power supplies, removable disk drive modules, RAID controllers, Passive Back Planes in stock!

Call **NOW** for information  
and **FREE** color catalog  
**1-800-394-4122**

VISA & MasterCard accepted  
Same day shipment!

Designed,  
Manufactured,  
Guaranteed by:

**CALIFORNIA  
PC PRODUCTS**

**408-638-9460**

**205 Apollo Way - Hollister, CA 95023**

Circle 106 on Inquiry Card.

276 BYTE SEPTEMBER 1995

## POURNELLE

The value of the course will depend entirely on the teacher choosing the right problems to solve. While this may be valuable, it's hardly new.

This is all of a piece with the new education fad that says it's not important what kids learn. "We teach them how to think, not what to think." That sounds wonderful until you ask the next question: What is it they are to think about? And must they discard 2000 years of history—largely a history of problem solving?

Long years ago when I was a student, there was an education fad called general semantics. By studying the science of meaning, we were going to solve all human problems. Like all education fads, this one contained some valuable (if not always original) insights. One of these was that humans are time binders: they don't have to learn by making the same mistakes their ancestors did. We don't have to discover all facts for ourselves.

It's clear that learning facts without understanding isn't much of an education, and students are highly motivated to play games rather than study facts. But the weakness of the problem-solving approach to education is that it's no use solving problems unless they are related to the real world; and while the ability to think things through is valuable, sometimes what you need is to be told how someone else did it.

We tend to learn to do what we've already done. Every sports coach understands this. Left to themselves, students generally won't stumble onto proper technique. Take fencing as an example. Hand a class of beginners weapons and protective equipment, and in a week, they'll have "problem-solved" their way to so many bad habits they may never be any good.

**I've recently seen essays criticizing the hypertext concept** as undeliverable hype. Now it's true that despite a decade of work and some financing from Autodesk, Ted Nelson and his associates didn't finish Xanadu; but that's not the main problem with hypertext.

The big problem is the hypertext concept itself. For example, there's Nelson's book, which you can start reading anywhere you like and read the chapters in any order. That's only a book, of course. His ultimate vision was Xanadu, computers connected on-line to give you all knowledge as hypertext, so that you could read everything in the world in any order you liked: the universe of knowledge with-

out any imposed structure.

It's attractive. We've all had the experience of going to an encyclopedia to look for one thing and emerging hours later. We often learn something that way, too; but I suspect the ones who learn the most are those who came to the encyclopedia with an intellectual framework into which they could put their new knowledge. Unorganized facts aren't science, they're merely anecdotes; it takes structured theory to turn anecdotes into data.

We don't have Xanadu yet, but we do have hypertext CD-ROMs. Most have little or no structure. You can peel off facts in any order you like. These may be useful to experts well grounded in the subject matter, but in the hands of beginners, they're more likely to be tools for amusement rather than for learning. The same is true of unstructured problem-solving education. It may generate enthusiasm, but all too often, it's the enthusiasm of the beginning fencer



handed weapons and a mask.

Lifelearn's educational approach is successful because they're building on a solid foundation. They don't teach the basics of veterinary medicine, nor are they concerned with a general education in problem solving. What they do is show already competent people new developments in their field, along with practical techniques they can use.

**Lifelearn has a large staff and a big budget.** Digital Frog International has neither.

I don't know how many frogs have been slaughtered to provide subjects for dissection in high school labs, but Digital Frog's "frog-friendly software" may help to change that. The Digital Frog is a CD-ROM developed by students on a shoestring; their entire capital investment, including a Power Mac, was under \$10,000.

They used a high-quality 35mm macro camera to take pictures of each stage of the dissection of a frog by an expert. Shots were made from many angles, and the whole thing was synchronized with a lecture. The pictures were digitized by turning the rolls into Photo CDs. They used an inexpensive JVC camcorder to capture images for QuickTime movies of frog activities, such as a frog catching a fly.

Then they added QuickTime animations, drawings, and diagrams, with excellent narration. The result is far more instructive—at least to me—than dissecting a frog, and there's no formaldehyde smell. The Digital Frog won the "best of show" award at AMTEC, and rightly so.

*continued*



# Go Above and Beyond Your Bottom Line



## The 1995 Business Week Forum of Financial Directors

### *The Financial Director: Sentinel of Value*

There's a new breed of Financial Director. One who's looking beyond corporate finance and taking charge of overall corporate strategy. Join *Business Week* and the Financial Directors of Europe's business community for face-to-face interaction and discussion on how today's Financial Director is doing more than ever to improve the bottom line.

17-18 October 1995  
The Regent London  
London, U.K.

#### In association with:

eunetcom  
Thomas Group, Inc.  
Union Bank of Switzerland  
Unisys Corporation

**Featured Speakers:** Peter D. Sutherland, former Director General, GATT/WTO  
Rob Abrahamsen, Managing Director and Chief Financial Officer, KLM  
Richard Lapthorne, Finance Director, British Aerospace PLC  
Sir David Frost OBE, Broadcaster/Interviewer

To register for the Europe Forum of Financial Directors, call +1(212) 512-2184, fax your response to +1(212) 512-6281, or mail this registration form to:

**Ann McKenna**  
Business Week Executive Programs  
1221 Avenue of the Americas, 36th floor  
New York, NY, U.S.A. 10020-1095

**FEE: US \$950**  
☐ Check enclosed  
☐ Bill me

**Bill my:** ☐ American Express  
☐ MasterCard  
☐ Visa

ACCOUNT NUMBER

EXPIRATION DATE

SIGNATURE

BYTE

NAME

TITLE

COMPANY

ADDRESS

CITY

STATE/COUNTRY

ZIP/POSTAL CODE

TELEPHONE

FAX

PRIMARY BUSINESS

ANNUAL REVENUE (US\$)

# BusinessWeek

EXECUTIVE PROGRAMS

*Beyond news. Intelligence.*





**"With grueling competition...  
SuperTCP [Suite]\*  
pulled ahead to garner  
Communication  
Week's MAX Award."**

*-Communications Week, April 24, 1995*

"Frontier's SuperTCP [Suite] for Windows boasted the most applications of any product we tested, yet it was among the easiest packages to set up."

*-Data Communications, Feb '95  
Tester's Choice Award*

"This product is the Swiss Army knife of the TCP/IP client: It has an implement for every application. [Including NFS, X Windows and Internet Access]"

*-LAN Magazine, April '95  
Product of the Year*

**Great reviews. Now judge for yourself.  
Call today for your free eval CD  
1-800-929-3054**



World Wide Web: [www.frontiertech.com](http://www.frontiertech.com)  
Email: [SuperTCP@frontiertech.com](mailto:SuperTCP@frontiertech.com)

## A Message to Our Subscribers

**F**rom time to time we make the BYTE subscriber list available to other companies whose products or services would be of interest to our readers. We take great care to screen these companies, choosing only those who are reputable. Furthermore, subscriber names are made available for direct mail purposes only; telemarketing calls are strictly prohibited.

Many BYTE subscribers appreciate this carefully managed program, and look forward to receiving information of interest to them via the mail. While we believe this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive promotional literature. Should you wish to restrict the use of your name, please send your request (including your magazine mailing label, name, address, and subscription account number) to:

**BYTE Magazine  
Subscriber Services  
PO Box 555  
Hightstown, NJ 08520**



## POURNELLE

If you teach high school biology, you'll definitely want the Digital Frog. It's an excellent example of what new technology and ingenuity can do for education.

**My latest trip was to Microsoft** for another dog and pony show about Windows 95. I've been using W95 on my main system for about three months now, going through a dozen "builds" as Microsoft fixes reported bugs. I have to say I like it; in particular, I like the user interface better than those of either Windows or OS/2. More important, though, it works.

There are some anomalies. I'll get to one of them in a moment; but the important thing is that I've had far less trouble getting used to W95 than I did Windows itself. Longtime readers will remember many columns in which I was screaming in frustration. That hasn't happened with W95.

One anomaly involves QEMM. W95 installs from a setup program, and it doesn't seem to matter whether you're installing over DOS, Windows, or an earlier W95. In each case, you get a warning that you're running QEMM, and you should disable it until the installation is finished, or else W95 may not identify all your hardware correctly. I suspect that mostly means that QEMM loads some device drivers into high memory and W95 isn't sure it will find them all; in any event, I have ignored that message in the past with no ill effects.

This last time, though, I decided to heed the message. I canceled the installation, removed all references to QEMM from my CONFIG.SYS and AUTOEXEC.BAT files, and put in DOS HIMEM.SYS and EMM386.EXE. Then, just for good measure, I exited W95 with the option to boot up in DOS and ran the DOS MEMMAKER.EXE program, answering "yes" to the question about running programs that need expanded memory.

The result wasn't good. Not only did I end up with DOS windows that were about 100 KB smaller—far too small to run most games—but my expanded memory had vanished as well. I rebooted. That automatically brings the machine back up in W95. When I ran the setup program again to finish my upgrade, I was told that I'd interrupted it last time and was warned there might be trouble; but there wasn't any difficulty, except that I got messages that EMM386 couldn't load, and my DOS windows remained tiny. I put up with that for about 5 minutes before I overwrote the CONFIG.SYS and AUTOEXEC.BAT files with my older versions containing QEMM. When I rebooted and let QEMM do its thing, I had no problems. My DOS



# TAKE ANY 5 BOOKS FOR ONLY \$4.95

when you join

## THE COMPUTER BOOK CLUB®

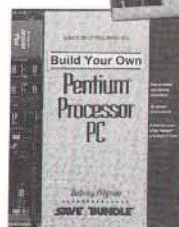
Values to  
\$194.80

3279P \$26.95

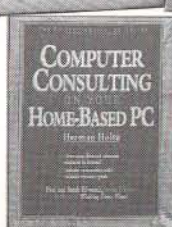
8819903 \$34.95

4491P \$24.95

8820987 \$29.95



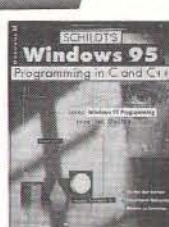
0501637 \$32.95  
Hardcover



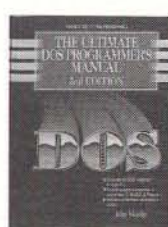
4424P \$14.95



0570639 \$45.00  
Hardcover



8820812 \$29.95



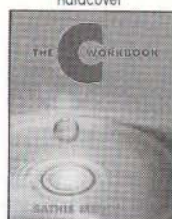
4221H-XX \$40.00  
Counts as 2/Hardcover



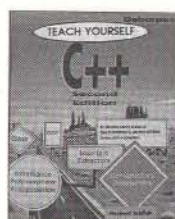
8821010 \$34.95



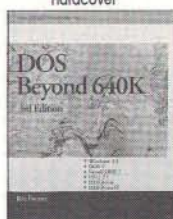
8819695 \$27.95



0415765 \$28.75



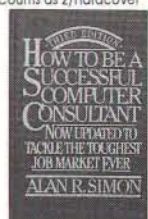
8820251 \$24.95



4356H \$39.95  
Hardcover



0549486 \$39.95



0576173 \$30.00  
Hardcover



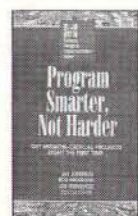
4210P \$21.95



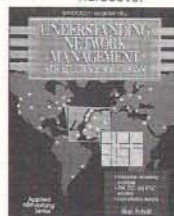
8820561-XX \$34.95  
Counts as 2



8815762-XX \$24.95  
Counts as 2



0212325-XX \$40.00  
Counts as 2/Hardcover



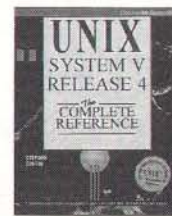
4085P \$19.95



0566933-XX \$70.50  
Counts as 2/Hardcover



8819806 \$29.95



881653X-XX \$29.95  
Counts as 2



0296626 \$29.95

### SPECIAL BOOK/DISK OFFERS



4191P \$32.95



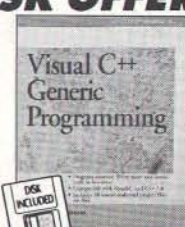
8820480-XX \$34.95  
Counts as 2



8820391-XX \$34.95  
Counts as 2



4503P-XX \$36.95  
Counts as 2



4461H-XX \$47.00  
Counts as 2/Hardcover



8820375 \$34.95



8819822-XX \$39.95  
Counts as 2

**As a member of The Computer Book Club®...** you'll enjoy receiving Club bulletins every 3-4 weeks containing exciting offers on the latest books in the field at savings of up to 50% off of regular publishers' prices. If you want the Main Selection, do nothing and it will be shipped automatically. If you want another book, or no book at all, simply return the reply form to us by the date specified. You'll have at least 10 days to decide. If you ever receive a book you don't want due to late delivery of the bulletin, you can return it at our expense. And you'll be eligible for FREE BOOKS through our Bonus Book Program. Your only obligation is to purchase 3 more books during the next 2 years, after which you may cancel your membership at any time.

If card is missing, write to: The Computer Book Club, A Division of McGraw-Hill, Inc., P.O. Box 549, Blacklick, OH 43004-9918  
All books are softcover unless otherwise noted. Publishers' Prices shown. If you select a book that counts as 2 choices, write the book number in one box and XX in the next. A shipping/handling charge & sales tax will be added to all orders. ©1995 CBC

PHONE: 1-614-759-3666 (8:30 a.m. to 5:00 p.m. EST Monday-Friday) • FAX: 1-614-759-3749 (24 hours a day, 7 days a week)



## POURNELLE

windows are 590 KB, and expanded memory works again.

**I've been using Franklin Quest's Ascend PIM** (personal information manager) for several years now. Telemagic is a far better contact manager, but it's designed for a much larger operation than mine. While there are many good things about Arabesque's Ecco, Ascend is good enough.

I've just installed version 5.0, and the upgrade illuminates a problem with W95 communications.

Despite the improvements in Procomm Plus for Windows, I unrepentantly use Procomm 2. I'm used to it. It runs on my Gateway HandBook (a 286) and does fine in a DOS window; but it has quirks. After I switched to W95, I had an annoying glitch. At first, Procomm couldn't find the modem. When I hit Escape and dialed again, lo!, all was well.

Naturally I blamed that on W95. Then I found that Ascend 4.0 worked just fine in Windows 3.11 and W95, but version 5.0 wouldn't dial in W95. Instead, I got a Windows message that some other device had the COM port. Franklin Quest had no advice—surprisingly, they have never tested

Ascend with W95—but they told me that Ascend 4.0 had its own dialer, while version 5.0 uses the Microsoft Dialer built into Windows.

You access the controls for the Microsoft Dialer through the Telephony button on the control panel. For reasons having to do with cable connections, I've used COM1 for the mouse and COM2 for the modem since DOS days. I had no problems with SideKick, Desqview, or any version of Windows; but with W95, no matter that I told Telephony to use COM2, Ascend 5.0 would report that the communications device was in use by another program. Finally, in exasperation, I shut down the machine, plugged the mouse into COM2, and connected the modem to COM1. Then I told both Procomm 2 and Telephony what I'd done. That fixed it. Ascend 5.0 dials just fine now.

Now I have discovered that if you give Procomm 2 an initialization string, it must have Control-M at the end, else it waits for a Return. I lost the Control-M while installing W95 (my fault I'm sure); it was never a problem with W95 itself. My apologies to Microsoft: they've been trying to fix that bug since I reported it.

Although that fixed the problem—Ascend 5.0 dials just fine now—alas, it has *not* fixed the “must access it twice” problem with Procomm 2, which remains as an annoyance. So it goes.

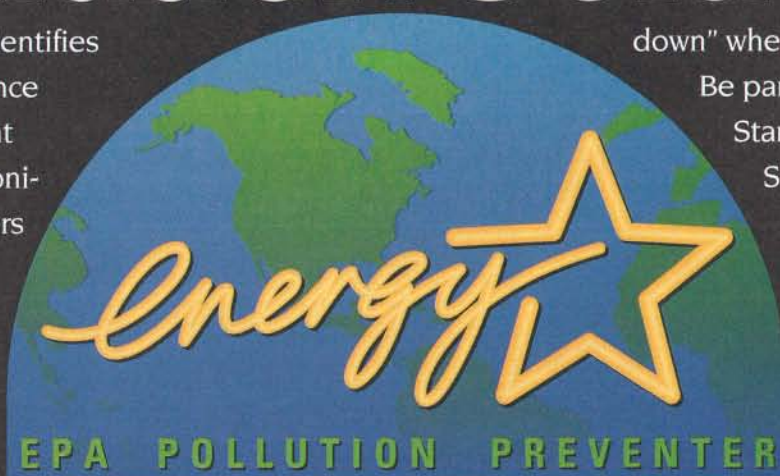
**OS/2 Warp Connect is nifty**, and it really is an improvement over standard Warp. In theory, it's still only Warp 3.0 with connectivity; in practice, they've incorporated some bug fixes and made installation simpler by adding more device drivers.

OS/2 is still harder to install than it ought to be. Every time I say that, I get letters from readers who bought one or another flavor of Warp and had absolutely no problems with the installation, and others who think it was easier to install than Windows ever was, so your mileage may vary. Once installed, OS/2 Warp Connect is pretty solid. Unlike W95, which still contains some 16-bit code, OS/2 is all 32-bit. With only a few windows open, there's little difference in speed between OS/2 Warp Connect and the test versions of W95; but if you keep a lot of windows open and do a lot of multitasking, the difference can be dramatic.

Using the IBM Pentium ValuePoint,

# Pollution Solution.

This symbol identifies high performance energy-efficient computers, monitors and printers that save you money and reduce air pollution by “powering



down” when not in use.

Be part of the solution.

Start buying Energy

Star<sup>SM</sup> equipment

today. To receive

a list of available

products, call

the Energy Star<sup>SM</sup>

Hotline at

202 775-6650.



Buy It And Save.



# Rich Information.

MCGRAW-HILL PUBLICATIONS ONLINE

## Information-Rich!

The Full-text Database with McGraw-Hill Credibility

Business Week  
Aerospace Daily  
Airports  
Architectural Record  
Aviation Daily  
Aviation Europe  
Aviation Week & Space Technology  
Biotechnology Newswatch  
Byte  
Chemical Engineering  
Coal Tech International  
Coal Week  
Data Communications  
Electrical World  
Electric Utility Week  
Engineering News-Record  
Federal Technology Report  
Hazardous Waste Business  
Independent Power Report  
Industrial Energy Bulletin  
Inside Energy/with Federal Lands  
Inside F.E.R.C.  
Inside N.R.C.  
Integrated Waste Management  
LAN Times  
Modern Plastics  
Nucleonics Week  
Open Computing (formerly UnixWorld)  
Platt's International Petrochemical Report  
Platt's Oilgram News  
Platt's Oilgram Price Report  
The Physician & Sportsmedicine  
Postgraduate Medicine  
S&P's Emerging & Special Situations  
S&P's Metals Week  
S&P's Review of Banking & Financial Services  
S&P's Review of Securities  
& Commodities Regulation  
Securities Week  
Telecom Strategy Letter  
Utility Environment Report  
The Weekly of Business Aviation

And More ...

You have it all, word for word. You're connected to an unabridged electronic library containing the full text of articles exactly as published, except graphics, in McGraw-Hill magazines and newsletters. And, best of all, because it's from McGraw-Hill, a leading international multimedia publishing and information services company, you get unparalleled excellence and reliability of content.

You access it fast and easy. You can search the entire McGraw-Hill database (over 50 of our leading publications) faster with more user-friendly ease than any other text. There are no cumbersome preliminaries...you get right into your hunt for information about companies, people and products on any topic.

And now you can make the information-rich connection to McGraw-Hill Publications Online today. For more information and our latest, complete list of publications, contact Andrea Broadbent at (609) 426-5523. Or fax this coupon to (609) 426-7352. Or send it to the address on the coupon.

Available online through

- Dialog® • NewsNet® • Dow Jones News/Retrieval®
- Lexis/Nexis® • F.T. Profile (U.K.)

Now Available on  
CD-ROM  
**THE MCGRAW-HILL  
ENERGY LIBRARY**  
PRODUCED BY  
**SILVERPLATTER  
INFORMATION**

### McGraw-Hill Publications Online

Princeton-Hightstown Road  
N-1  
Highstown, NJ 08520 U.S.A.

- ☐ Send me the complete list of your publications online.
- ☐ Send me details on The McGraw-Hill Energy Library produced by SilverPlatter Information.



Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_

State \_\_\_\_\_

Zip/Postal Code \_\_\_\_\_

Country \_\_\_\_\_

Tel. \_\_\_\_\_ BY \_\_\_\_\_



I've managed to get three simultaneous communications programs—two using 9600-bps modems, and one using a serial port—as well as a print job to run in OS/2. The printing was pretty slow, but the communications tasks worked without losing data. I haven't tried that with W95, but I don't need to. Just keeping a number of windows open (and doing nothing) will noticeably slow down W95.

The big new feature of OS/2 Warp Connect is built-in peer-to-peer networking capability. OS/2 Warp Connect supports IBM LAN Server 2, 3, and 4, and the LAN Server on AIX and AS/400. You can connect to Windows for Workgroups, Windows NT Server, W95, and the Microsoft LAN Manager, as well as all versions of Novell NetWare. The feature set is comparable to W4WG, with cut and paste across the network. I mildly prefer the W95 user interface, but the Warp interface is good enough.

OS/2 Warp Connect works just fine, with one exception. In Windows and W95, if you do Ctrl-Alt-Del, you get a dialog box that gets you back to the OS, where

you can choose to shut down individual applications or the entire system. Warp doesn't do that. If you press Ctrl-Alt-Del, the system will reboot without further ceremony. Alas, that means that if you run a particularly badly behaved application, you may find yourself unable to get back to OS/2. That happens more often with bad Windows applications in Warp, but I've had it happen with a DOS program as well, and it's a terribly frustrating experience.



**One reason Microsoft held its latest dog and pony show** was to impress journalists with just how many software developers are writing applications for W95; it worked. About a hundred companies, hardware and software, had booths in a miniature trade show. The booths were small, not flashy, and the emphasis was on technical demonstrations. It reminded me of the early days of the West Coast Computer Faire.

Naturally, the Microsoft Applications Group was showing the most products, including new versions of Microsoft Office; but there were many others. Traveling

Software was there with new versions of LapLink for Windows. You'll really like what they can do with W95. Philippe Kahn, still chairman of Borland but no longer running that company, was there demonstrating Starfish Software's SideKick for Windows.

Symantec was there, with a new version of Norton Utilities for W95. I use that, and I'd hate to live without it. They also have a new Norton Navigator (a desktop replacement) for W95. I've got it, but I don't really feel the need; I rather like the W95 interface. But if you get W95, be sure to get the appropriate Norton Utilities.

You'll also need the *Windows 95 Resource Kit* from Microsoft Press. It has over 1300 pages and goes into great detail on stuff you'll want to know. There's a good section on using long filenames and what happens if you transfer those files to systems that don't support long filenames. Reading that will lead you to look into long file extensions—you're no longer limited to three characters after the dot—and how those can be used to tell W95 things about a file. That will lead you to read the section on the Registry, a W95 trick to cut down on the sizes of INI files.

*continued*

## URGENT—YOUR INPUT NEEDED

### Platform Issues in Applications Development

Dear Reader:

To improve BYTE's coverage of technology in the State of the Art section, we'd like to get your feedback about what specific topics, areas, and products we should be considering, and in what ways. Specifically, we're planning later this year to take a look at the development of software for new (as well as for multiple) platforms. We want to explore the issues involved in developing applications to run on brand new OSes or those in a state of flux (as with Windows 95 in its beta days); at cross-platform development tools, problems, and capabilities; and at what the advent of (at least partially) object-oriented OSes means for applications developers.

These are complex questions and to do them justice we'd like to hear your views—what you're interested in, what you'd like to see us report on and analyze. We want to hear your ideas and find out about concerns that we may not fully appreciate or be aware of. Also, we'd like your help in knowing who are the people we should be talking to—users, vendors, researchers—you tell us.

To let us know what you think, please use the following as a template to send us, via E-mail, an ASCII text file with your comments. Please be sure to include the <FIELDNAMES> with their angle brackets, followed by your information and comments. And thanks very much for your help.

Please E-mail the completed form to: [surveys@bix.com](mailto:surveys@bix.com)

<TOPIC>  
App Development for Platforms

<LASTNAME>  
Ziegler

<FIRSTNAME>  
Teddy

<TITLE>  
Sr. Software Engineer

<COMPANY>  
Universal Applications Unlimited

<PHONE>  
800-555-4321

<EMAIL>  
tz@host.domain

<COMMENTS>

This is where your comments go. Be as brief or as long as you want. Tell us what you think, what you need, what you want to know more about. Tell us what you're doing. Tell us who we should be talking to.



# Maximize Your Marketing Dollars With BYTE Reprints!

**BYTE Reprints serve as high-quality, inexpensive promotional tools for:**

- Trade show handouts
- Direct mail campaigns
- Dealer/distributor promotions
- Training and educating key personnel
- Presentations at conferences/seminars

**And there's more!**

- BYTE reprints can be customized with your company name, logo, product picture, etc.

**Call today for information and quantity prices.**

Susan Monkton

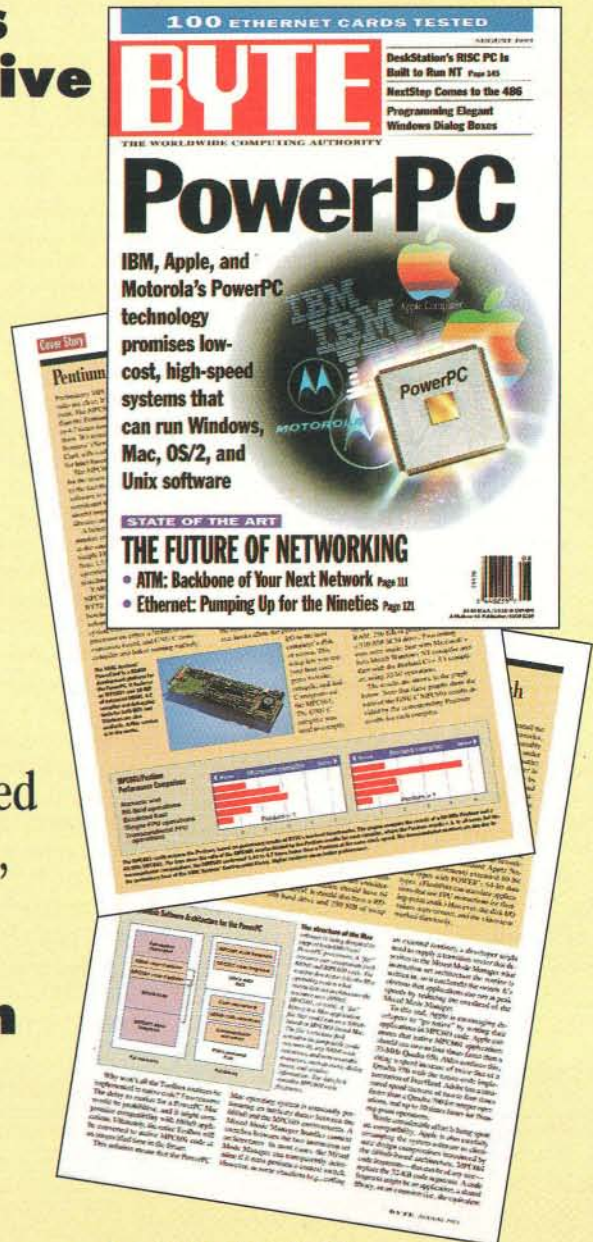
BYTE Reprint Department

One Phoenix Mill Lane, Peterborough, NH 03458

Phone: 603-924-2618

Fax: 603-924-2683

Minimum order: 500



**BYTE**

The Magazine of Technology Integration

Mc  
Graw  
Hill



**Bottom-line question for Windows users:** Should you change OSes? In my judgment, yes you should. W95, Windows NT, and OS/2 Warp Connect are all significant improvements over Windows and W4WG. You'll be better off with one of those.

Deciding which one isn't so easy. If you're operating in a large corporate environment, you should probably be considering Windows NT versus OS/2 Warp Connect plus OS/2 LAN Server. You'll certainly want to consider Lotus Notes, and now that IBM is buying Lotus, you'll want to watch developments there.

For home users, the choice is a bit simpler. The less you like fooling around with your machine, the more you're going to appreciate W95. You're far more likely to have a painless upgrade going from Windows to W95 than you will when switching to Warp.

One big attraction of OS/2 has been that it is a better DOS than Windows and, for that matter, a better DOS than DOS. That remains true, but it's not a better DOS than W95—and it's certainly not a better Windows than W95. The more you run Windows (not W95, just Windows) applications, the more you'll appreciate W95. And, of course, we don't even know what IBM plans for handling applications written for W95 itself. We do know there will be far more applications written for W95 than for OS/2.

I'm keeping both. We'll continue to run OS/2 Warp Connect, but I have to say my prime machine is already running W95. That could change. Stay tuned.

**It's silly, but I'm still taking two laptops on trips.** The Gateway Liberty 2000 remains my favorite for working on airplanes and in meetings, but the Zenith Z-Noteflex gets set up in my hotel room and is used for heavy-duty work there.

Part of that is Zenith's reliability. The Gateway Liberty is reliable enough, but the catch that holds the battery is next to the one that secures the removable hard drive, and I have now twice managed to unlatch that drive. The result is that the drive comes slightly loose, and you have to reboot. I've never lost any data this way, but it worries me. Of course, I can fix the problem forever with duct tape. I'm not really worried about the Liberty.

The other part is the keyboard. The Z-Noteflex's keyboard is just better for typing when I'm trying to bang out text. It's not that the Liberty's keyboard is bad, just that the other one is better. And the Z-Noteflex has a built-in floppy drive, while the Liberty's floppy drive is an external attachment. This makes the Z-Noteflex heavy enough that I don't really want to put it into a briefcase.

The upshot is that I've got one of those wheeled carry-on flight bags, and when I stuff it with two computers, their power supplies, a couple of manuals, and my Ascend notebook, the thing is heavy enough to leave ruts in the tarmac. But I've never had any problem stuffing it into an overhead rack, and I need the exercise.

The Z-Noteflex has a Data Race Redi-Card RC-1496 data/fax modem. It works fine at 9600 bps. But it needs a special cable that plugs into the PCMCIA card on one end and connects to a phone line on the other; more than once when I've been online, something jarred the cable connector enough to make the system hang up.

By contrast, the Liberty has a Megahertz 14.4-Kbps PCMCIA data/fax modem with XJack. That also works just fine at 9600 bps, and the XJack connector lets you plug a normal phone cord into it. I've never had that shake loose. I've tested both modems for months now, and while I have

no preference on performance, the XJack's convenience is a deciding factor. I recommend the Megahertz PCMCIA data/fax modem card.

**It's easy to forget that the first A in NASA** stands for aeronautics; but in fact NASA Ames does some great work. One such is a software simulation of a Boeing 737. As its developer Steve Casner put it, there's something uncanny about carrying around the brains of a big modern airplane under your arm. The simulation runs on a Mac PowerBook. If you're interested in finding out more, you can E-mail him at casner@eos.arc.nasa.gov, or write to Stephen Casner, NASA Ames, Mail Stop 262-4, Moffett Field, CA 94035.

The book of the month is *Crime*, edited by James Q. Wilson and Joan Petersilia (ICS Press, 1995). This will tell you more than you want to know about crime in this country. Essays are presented from nearly every rational point of view. It's not fun reading, but perhaps it's time citizens gave some heavy thought to the problem.

Two computer books of the month. The first one is Jeannette Lawrence's *Introduction to Neural Networks* (California Scientific Software, 1993). This isn't easy reading, but no book on neural networks is; but it is comprehensible when it talks about back propagation and the like. Neural networks are becoming increasingly important as computers get more powerful.

The second computer book of the month is by Ronny Richardson, *The Ultimate Batch File Book* (Tab/McGraw-Hill, 1995). It certainly lives up to its title. There are batch files for MS-DOS, PC-DOS, Novell DOS 7, OS/2 Warp, and Windows; and it comes with a CD-ROM of batch and help files. Studying well-written applications is the best way I know of to learn how to write them.

Next month: more on connectivity, and a whole mess of small applications. ■

*Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on the Internet or BIX at jerry@bix.com.*



In **Ascend 5.0** (\$149.95), some changes are for the better, and I expect overall it's a genuine improvement. Contact **Franklin Quest Co.**, Salt Lake City, UT, (800) 877-1814 or (801) 975-9992; on CompuServe, go franklin. **Circle 1274 on Inquiry Card.**

The **Digital Frog** (US\$170) is an excellent example of what new technology and ingenuity can do for education. Contact **Digital Frog International**, Puslinch, Ontario, Canada, (519) 766-1097; dfi@sentex.net. **Circle 1275.**

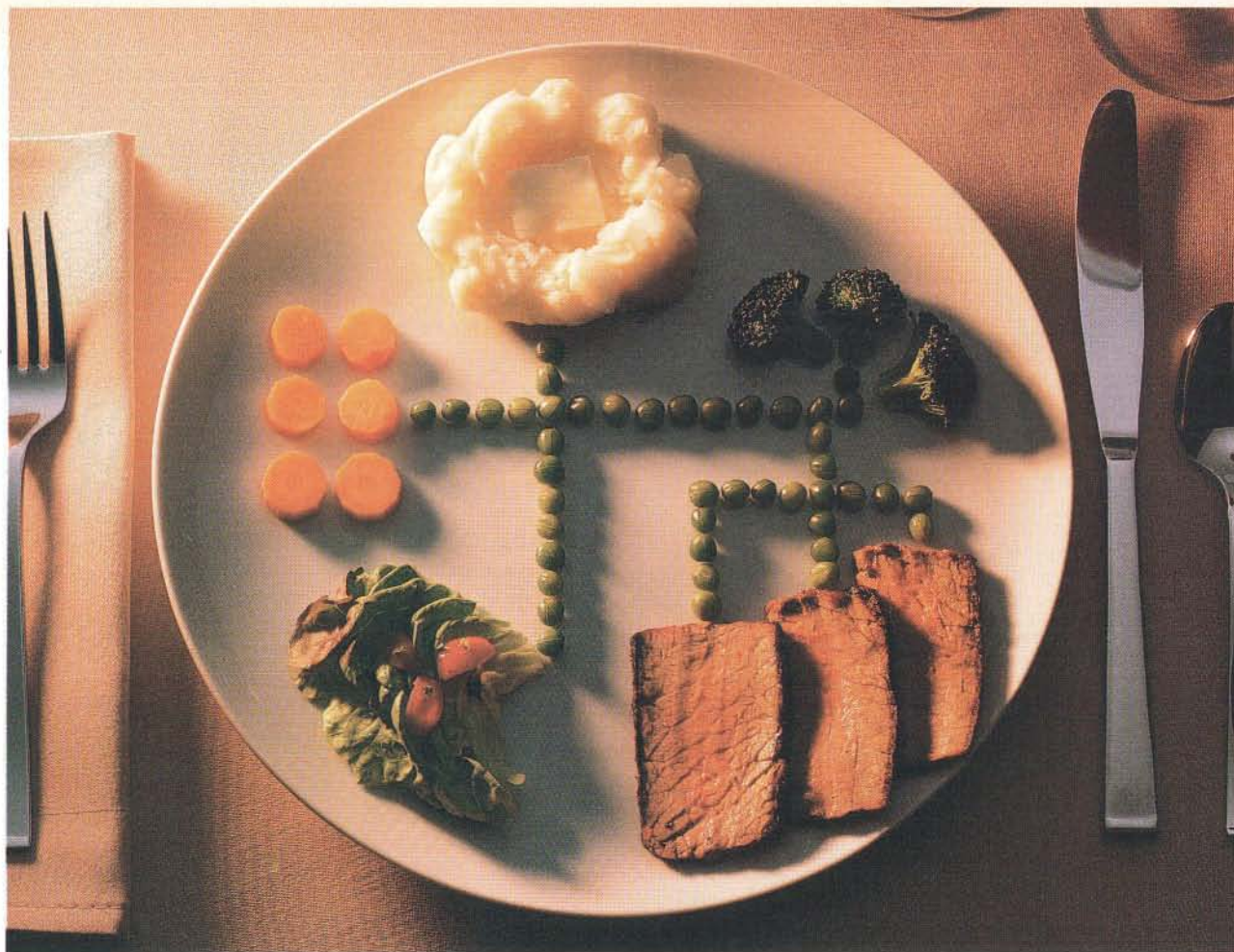
The **Interactive Multimedia Self-Study Modules** (per module, US\$299) for veterinary medicine impressed me a

lot. Contact **Lifelearn V., Inc.**, Guelph, Ontario, Canada, (800) 375-7994 or (519) 767-5043; mlgol@ovcnet.uoguelph.ca. **Circle 1276.**

The big new feature of **OS/2 Warp Connect** (fullpack edition with Win-OS/2 code, \$299) is built-in peer-to-peer networking capability. **IBM Corp.**, Austin, TX, (800) 342-6672 or call your local IBM dealer; <http://www.ibm.com>. **Circle 1277.**

The **PCMCIA data/fax modem with XJack** (\$249) works just fine at 9600 bps, and the XJack connector lets you plug a normal phone cord into it. Contact **Megahertz Corp.**, Salt Lake City, UT (800) 527-8677 or (801) 320-7000; <http://www.xmission.com/~mhz>. **Circle 1278.**





# FOR THOSE WHO CAN'T SEEM TO GET NETWORKING OFF THEIR MIND.

Consumed by the need to network? Then you really should attend NetWorld+Interop® this fall in Atlanta. You'll meet with over 500 of the industry's top LAN, WAN and telecommunications suppliers. You'll explore the world's most diverse, fully deployed event network, the InteropNet™, as it runs the latest in high-speed networking, client-server, Internet access and more. Best of all, you'll test drive new solutions vital

to your business and see how well they *really* work. NetWorld+Interop is, by far, the fastest, easiest way to check out all the hottest networking technologies. Not to mention the perfect place to improve how your business communicates. So don't wait another minute. Make your reservation for Atlanta right away.

## NETWORLD+INTEROP 95

**FREE VIP PASS • ATLANTA, GA • SEPTEMBER 27-29 • GEORGIA WORLD CONGRESS CENTER**

Name \_\_\_\_\_ Company \_\_\_\_\_

Address \_\_\_\_\_ City, State, Zip \_\_\_\_\_

Phone/Fax \_\_\_\_\_ Fax: 415-525-0199 • Mail: N+I 95, P.O. Box 5855, San Mateo, CA 94402-0856

**GET CONFERENCE INFORMATION VIA THE WEB AT <http://www.sbexpos.com> • QUESTIONS? CALL 800-488-2883**

A120

The conference program runs September 25-29. Outside the U.S. call 415-578-6900. © 1995 SOFTBANK Exposition and Conference Company (SOFTBANK Expos). Interop is a registered trademark of SOFTBANK Expos. NetWorld is a service mark of Novell Inc. All other names are the property of their respective holders.



# WHAT'S NEW Hardware

## PREVIEW PC NOTEBOOKS

### Impressive Battery Life in a Laptop Pentium PC

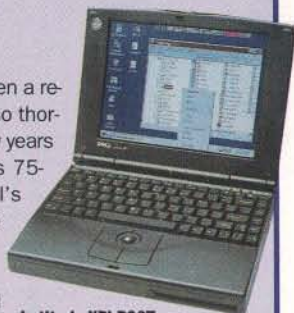
Dell's Latitude line of laptops has been a remarkable resurgence for a company so thoroughly out of the laptop business a few years ago. The new Latitude XPi combines 75- and 90-MHz Pentium power with Dell's renowned battery life. We tested the XPi P90T, which uses Intel's new low-voltage 90-MHz Pentium. The P90T has an active-matrix TFT screen, and our test unit came with 16 MB of RAM and an 810-MB hard drive.

The XPi P90T is smart and aggressive about stretching its battery life—so much so that it confounded our Thumper 2 battery tester. On a recent trip from Manchester, New Hampshire, to San Francisco, we used the XPi for at least 3 hours' worth of editing, and there was battery life to spare when we arrived in California.

The low-voltage Pentium is designed specifically for mobile applications and runs at 3.3 V externally but at just 2.9 V internally. As a result, it runs cooler than previous 90-MHz Pentiums and consumes less power. Combined with high-power lithium-ion batteries, this gives the P90T remarkable battery life. These low-voltage Pentiums will soon show up in everyone's laptops, but Dell's Latitude XPi P90T is one of the first to have them.

The XPi is not perfect. It lacks some features that we've come to expect in high-end laptops, such as built-in sound support. And it was dis-

—Rex Baldazo



**Latitude XPi P90T**

(90-MHz Pentium, active-matrix TFT screen) As tested, with 16 MB of RAM and an 810-MB hard drive, \$5398; base configuration, with 8 MB of RAM and a 340-MB hard drive, \$4699.

Dell Computer  
Austin, TX  
(800) 289-3355  
(512) 338-4400  
<http://www.dell.com/>  
**Circle 976 on Inquiry Card.**

#### Performance

Integer index	.99
Floating-Point index	1.12
(A 90-MHz Dell Pentium = 1)	

appointing that the screen supports only 640- by 480-pixel resolution. But for people who need to do serious work during long plane rides, the XPi is just about perfect.

#### A SPARCSTATION 5 COMPATIBLE

The PowerLite 110 integrates a 110-MHz MicroSparc II microprocessor, up to 2.4 GB of internal hard disk storage, TGX graphics acceleration, an internal floppy drive, a fax modem, and a 10.4-inch, 1024- by 768-pixel, flat-panel color display, all in a compact 8½-pound package (from \$12,995). Configurable options include four memory configurations (32, 64, 96, and 128 MB); your choice of two displays, the flat-panel color dis-

play or a Colorplus 640- by 480-pixel active-matrix LCD; and storage configurations from 810 MB to 6.4 GB, with an optional PowerLite Peripheral Expansion Unit. Other features include a 10Base-T AUI for Ethernet connection, a 10-Mbps SCSI-2 port, two RS-232 ports, a Centronics port, an 8-bit audio connection (with internal speaker and microphone), a connector for an external monitor, and SBus expansion slots for use with the optional PXU.

Contact: RDI Computer,  
Carlsbad, CA, (800) 734-5483  
or (619) 929-0992;  
<http://www.rdi.com>.

**Circle 980 on Inquiry Card.**

#### MULTIPROTOCOL NETWORK CD-ROM SERVER

Now users running Windows for Workgroups, Windows 95, or Windows NT, as well as those in an OS/2 or Unix environment, can simultaneously share networked CD-ROM information. The Axis 851/951 Network CD-ROM Server supports Ethernet and Token Ring, respectively, and lets you attach up to six external CD-ROM drives or jukeboxes in a series. With a built-in Etrax RISC processor and file cache, the 851/951 Network CD-ROM Server (Axis 851 for Ethernet, \$899; Axis 951 for Token Ring, \$1099) can achieve throughputs of up to 600 KBps.

Contact: Axis Communications, Woburn, MA, (800) 444-2947 or (617) 938-1188;  
<http://www.axis.se/>.

**Circle 983 on Inquiry Card.**

#### 2-GB MINICARTRIDGE DRIVE

The Panther Mini 2000, a 3½-inch SCSI-2 tape drive, comes with a 2-GB Sony QIC-Wide data cartridge, Arcada Backup for DOS/Windows software with data compression, and cables. Available in internal and external configurations (\$549 and \$659, respectively), the Panther Mini 2000 drive automatically formats the data cartridge and verifies data as it records. You can back up 36 MB of data per minute, or approximately 1 GB in 55 minutes. The Panther Mini 2000 also features automatic load and eject and a protective door that closes behind the cartridge. Contact: Tandberg Data, Simi

Valley, CA, (800) 826-3237 or (805) 579-1000.

**Circle 982 on Inquiry Card.**

#### POWER MANAGEMENT FOR PRINTERS

Nightware (\$109.95) turns off your printer during periods of inactivity and automatically restores power to it when needed. When Nightware restores power to the printer upon receipt of data, its momentary poll-and-store feature prevents an application time-out while the printer warms up. When the printer is ready, Nightware reconnects it to the host to resume printing.

Contact: Micro Energetics, Fairfax Station, VA, (800) 948-2099 or (703) 250-3000.

**Circle 979 on Inquiry Card.**

#### 15-HOUR ZINC-AIR BATTERY ▼

The AER Energy PowerPro (\$399) can power Toshiba Satellite T1900 series systems, Satellite Pro T2400 series systems, and T4700C, T4800CT, and T4850CT portable computers for up to 15 continuous hours between charges. The PowerPro battery fits under your computer, attaching via the battery socket. The Toshiba AC adapter recharges the PowerPro. When you attach the battery to your PC, you still have access to all your com-



puter's drives and ports.

Contact: AER Energy Resources, Smyrna, GA, (800) 769-3720 or (404) 433-2127;  
[75321,3445@compuserve.com](mailto:75321,3445@compuserve.com).

**Circle 981 on Inquiry Card.**





### PENTIUM MULTIMEDIA SYSTEM ▲

The Multimedia Quadstation series of multimedia systems feature Lasonic surround-sound amplified speakers, Sound Blaster 16 cards, and Teac quad-speed CD-ROM drives. Each system (486DX2-66, \$1578; Pentium/100, \$2148; 486DX4-100, \$1698; Pentium/90, \$1998) ships with an 850-MB hard drive, 8 MB of RAM, a 256-KB cache, a 1.44-MB floppy drive, a PCI enhanced-IDE controller, and a 2-MB PCI local-bus graphics card with an ATI Windows accelerator. All systems also include a Sceptre 15-inch flat-screen non-interlaced digital-control SVGA monitor with 0.28-dpi, 1280- by 1024-pixel resolution.

*Contact: Intellicomp Technologies, El Monte, CA, (800) 468-3696 or (818) 582-8096.*

**Circle 995 on Inquiry Card.**

### SPARC 5—COMPATIBLE WORKSTATION

Incorporating a 110-MHz MicroSparc II processor, the SWS5/110 comes with five 32-bit master/slave SBus slots capable of supporting double- or triple-width SBus cards, a 64-bit AFX graphics bus, up to 256 MB of internal RAM, and 100 percent binary compatibility with the Sun SparcStation 5. The SWS5/110's storage options include an internal 644-MB double-speed Photo CD-ready CD-ROM, two internal hard drives, and one internal 3½-inch 1.44-MB floppy drive. A base-configured workstation with system board, chassis, keyboard, mouse, and power supply costs \$3495; a complete system with

a 110-MHz MicroSparc II CPU, 32 MB of memory, a 1-GB hard drive, a Turbo GX graphics card, and a 17-inch color monitor costs \$7495.

*Contact: Integrix, Newbury Park, CA, (800) 300-*

*8288 or (805) 375-1055;*

*<http://www.integrix.com>.*

**Circle 984 on Inquiry Card.**

### ERASING ULTRAPEN

The Erasing UltraPen lets you erase as you would with a real eraser—the harder you press, the more it erases—and offers up to 256 levels of pressure. For software that's not eraser-aware, the \$89.99 device allows you to select and delete text or cells with one stroke. Also available are the WideBody UltraPen With Pencil (\$125) and the DuoSwitch UltraPen (\$125), which meets multiple-mouse-button standards in Windows and Unix OSes.

Wacom's latest graphics tablets include the ArtPad II with Erasing UltraPen (\$174.99), ArtZ II 6 × 8 with Erasing UltraPen (\$389.99), ArtZ II 12 × 12 with Erasing UltraPen (\$539.99), ArtZ II 12 × 18 with Erasing UltraPen (\$869.99), and ArtZ II 18 × 25 with Erasing UltraPen (\$2449.99).

*Contact: Wacom Technology, Vancouver, WA, (800) 922-6613 or (360) 750-8882.*

**Circle 992 on Inquiry Card.**

### INTEGRATED AUDIO/TELEPHONY PRODUCT

Featuring audio, fax, and modem functions, the TeleCommander 2500XL (\$229) integrates a 16-bit CD-quality sound card that works with Sound Blaster Pro-compatible applications and a 14.4-Kbps Rockwell modem (V.32bis) and 14.4-Kbps fax (V.17). The all-in-one desktop-communications solution also includes call screening, call forwarding, and remote-message access, as well as fax-forwarding, fax-on-demand, and pager-notification capabilities. The package comes with Thought Communications' FaxTalk Messenger and FaxTalk Speakerphone; Radish Communications' Voice View technology, which lets you send and receive files during a single telephone conversation without hanging up; and on-line-services software for America Online, CompuServe, Imagination Network, and Internet access.

*Contact: Diamond Multimedia Systems, San Jose, CA, (800) 468-5846 or (408) 325-7000; <http://www.diamondmm.com>.*

**Circle 991 on Inquiry Card.**

### PCMCIA MODEM WITH STATUS LIGHTS ▼

U.S. Robotics' Courier V. Everything PCMCIA PC Card with DataView (\$575) has four LEDs that let you monitor power, send, receive, and on-line functions during a fax or data transfer. The card provides connectivity to industry-standard V.34 modems;

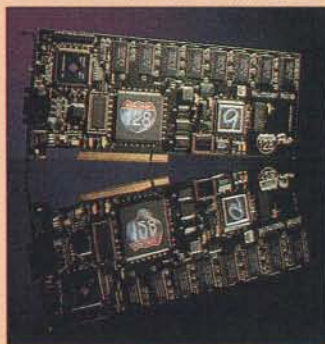


backward compatibility with proprietary standards, such as V.42 and V.42bis; and compatibility with V.32bis and slower-speed modems. Other features include flash ROM upgradability, remote configuration, link security, dial security, and Easy Install software. Also available is a 14.4-Kbps version of the device, the Courier V.32bis PCMCIA PC Card with DataView (\$499).

*Contact: U.S. Robotics, Skokie, IL, (800) 877-2677 or (708) 982-5010.*

**Circle 990 on Inquiry Card.**

### PLUG-AND-PLAY MPEG CARD



The 9FX-PlusMPEG card (\$199) for PCI-based PCs lets you load and view MPEG video files without having to change your Windows settings. In addition to high-quality video, the card feeds synchronized 16-bit CD-quality audio through a mini-jack, which you can connect to stereo speakers or another external amplifier or back into your PC's 16-bit sound card for sound-mixing. To take advantage of the 9FX-PlusMPEG card, your system needs a PCI graphics accelerator with DCI support.

*Contact: Number Nine Visual Technology, Lexington, MA, (800) 438-6463 or (617) 674-0009; on CompuServe, go nine.*

**Circle 977 on Inquiry Card.**



# WHAT'S NEW Software

## MAINFRAME-CLASS SECURITY FOR PCs AND LANs



**StopLight 95 (single copy, \$295)** prevents unauthorized PC access, illegal and unwanted file copying, configuration changes, and other security problems on individual and networked Windows PCs. The LAN version lets you control and automate security from a central workstation. You can restrict access to individual drives, partitions, directories, and individual files; specify kinds of access, such as read, write,

create, and delete, for each of these levels; and prevent users from copying program executables to or from machines. The program also includes the Drive-In AntiVirus utility, which scans and disinfects hard and floppy drives and network volumes for boot-track viruses before they can cause harm.

Three versions are available: **StopLight 95/LAN**, client and server security software for centralized control of all LAN workstations; **StopLight 95/PC**, which offers full security features for a single PC, with the ability to define profiles for up to 255 users; and **StopLight 95/ELS**, an entry-level security package without antivirus capabilities that supports two user profiles.

Contact: Security Integration, Lexington, MA, (800) 888-5031 or (617) 861-8800.

Circle 996 on Inquiry Card.

## 32-BIT IMAGING SOFTWARE

A high-level C library with optimized commands for image processing, pattern matching, blob analysis, gauging, and OCR (with an optional module), MIL-32 is a 32-bit version of the Matrox Imaging Library that allows you to build applications using only a few lines of code. The library (US\$1495) supports Windows NT, 32-bit DOS extenders, and Win32s and runs on VGA imaging boards.

Contact: Matrox Electronic Systems, Dorval, Quebec, Canada, (800) 361-4903 or (514) 685-2630; [imaginginfo@matrox.com](mailto:imaginginfo@matrox.com).

Circle 998 on Inquiry Card.

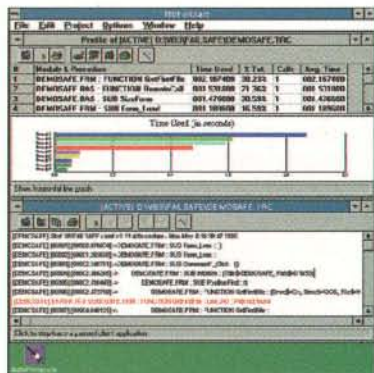
## DEBUG, ANALYZE VISUAL BASIC APPLICATIONS ▶

The VB/FailSafe (\$179.95) integrated debugging and performance-analysis system for Visual Basic for Windows integrates error interception, program tracing, and performance profiling into a single software tool. The package includes FS/Interceptor, which sta-

bilizes a project and stops system crashes by intercepting and coding all errors by type, class, number, and description; FS/Tracer, which aids in isolating event-driven and client/server bugs, as well as bugs lurking within compiled executable programs that Visual Basic's built-in step-trace is unable to find; and FS/Profiler, which uses information from FS/Tracer to produce graphs and tables showing program performance, routine by routine.

Contact: Marquis Computing, Pomfret Center, CT, (800) 818-1611 or (203) 963-7065; [76120.2413@compuserve.com](mailto:76120.2413@compuserve.com).

Circle 1000 on Inquiry Card.



## INTERNET CLIENT/SERVER SOFTWARE

Operating in the Windows environment, MindWire 1.0 (eight-user license, \$495) helps you to create a dynamic multimedia online service offering modem, network, and Internet connectivity options. The MindWire Client software contains messaging, file-library, E-mail, and chat features. MindWire provides support for image and sound files, spell checking for E-mail, viewing user photos, auto-viewing downloaded files, and scanning message responses. MindWire performs multiple functions simultaneously, including downloading and uploading files, chatting with other users, and reading E-mail.

The MindWire Server lets you manage and configure application features such as account information, security, file-library folders, and messaging forums. MindWire controls user privi-

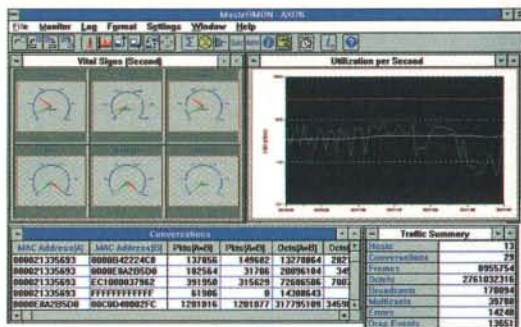
leges and security. An audit trail records user transactions on the Server and generates reports to monitor your system's activity. The Client Application Manager performs automatic on-line software updates and installation of new applications.

Contact: Durand Communications Network, Santa Barbara, CA, (805) 961-8700; <http://www.durand.com>.

Circle 1011 on Inquiry Card.

## DISTRIBUTED NETWORK-MONITORING SOFTWARE ▼

MasterMON 1.0 displays the activity of a selected Ethernet or Token Ring LAN segment via RMON agents. The program transparently handles SNMP functions and takes advantage of Windows' multitasking capabilities by letting you execute several concurrent instances of MasterMON on the same machine. MasterMON (single license, \$595) displays traffic from all stations, or nodes, present on the



monitored segment; offers several real-time display modes; provides user-configurable alarms; includes a baselining feature that automatically learns the normal traffic levels of the network and configures MasterMON accordingly; generates snapshot reports of network activity at configurable time intervals; and offers real-time graphing capabilities.

Contact: Triticom, Eden Prairie, MN, (612) 937-0772; <http://www.triticom.com>.

Circle 1003 on Inquiry Card.





## LANTASTIC POWER SUITE ▲

An integrated product, LANTastic Power Suite (one-user software-only kit, from \$199) contains the LANTastic network OS and communications software. In addition to LANTastic, the suite includes Lotus cc:Mail communications software, the Lotus Organizer networked group scheduler and PIM, Cheyenne Communications' BitWare fax and modem communications software and BitShare modem-sharing and pooling software, and Netcom NetCruiser Internet-access software.

Contact: Artisoft, Tucson, AZ, (800) 233-5564 or (602) 670-7100; <http://www.artisoft.com>.

Circle 1013 on Inquiry Card.

## EXCHANGE BINARY FILES VIA FAX ▼

With 3D Fax, you can send and receive editable or executable files via standard fax. In addition, 3D Fax includes compression and image-processing features that allow you to reduce fax-transmission time by at least 90 percent. You can also send color pictures and multimedia files. When you

send a file to a fax machine, it's visually uninterpretable. You scan the printed image into a computer, and the 3D Fax software (standard version, \$99; professional version, \$199) restores the file to its original

content and format and opens it in the software application in which you created it.

Contact: InfoImaging Technologies, Palo Alto, CA, (800) 966-1140 or (415) 960-0100; <http://www.infoimaging.com>.

Circle 1012 on Inquiry Card.

## IMAGE EDITING FOR THE MASSES

Image'n'Bits 2.0 (\$79) can convert images, regardless of their origin, to OLE objects ready for you to edit, tile, and drag and drop into other applications or convert to other file formats. The program allows you to embed or link an image file into another application for editing without having to exit that application. You can also tile and convert to thumbnails objects stored inside the Image'n'Bits albums. Image-processing functions include flip, mirror, convert to negative, false color substitution, smooth, blur, sharpen, posterize, edge detection, pixelize, and emboss. Distortion filters include pinch, spiral, fish-eye, paint, star, melt, and wavy.

Contact: Bananas Software,

Paramus, NJ, (800) 653-4624 or (201) 265-9855; [banana@ios.com](mailto:banana@ios.com).

Circle 1008 on Inquiry Card.

## METERING SOFTWARE FOR NETWORK LANs

LANrecord 1.0 provides metering and chargeback for software applications, suite-based products, files, and other LAN resources, such as network connections. The program helps you comply with software application licenses and provides LAN administrators with data about the computing costs incurred by users and departments. An export feature lets you export chargeback information to external applications. LANrecord 1.0 (base server, \$595; additional server licenses, \$395) maintains in its database information that's gathered during the metering process and offers real-time-dynamic and history-reporting features.

Contact: Horizons Technology, San Diego, CA, (800) 828-3808 or (619) 292-8331; <http://www.horizons.com>.

Circle 997 on Inquiry Card.

## KEEP YOUR VISUAL BASIC CODE IN ORDER

The Polisher (\$149) formats, comments, and spell-checks your Visual Basic programs. You can automatically generate a comment block at the start of every routine and insert comment blocks at the start of modules and procedures, with variables such as developer name, company, and date. The Polisher lets you remove or insert blank lines before or after block constructs throughout the code and allows you to specify the number of spaces to auto-indent and the indent options for declarations, Select Case, and IF... THEN... ELSE formatting.

Contact: Aardvark Software, Teaneck, NJ, (201) 833-4355; 70544.1372@compuserve.com.

Circle 1015 on Inquiry Card.

## Software Update

The **Track 3.0 for Windows** LAN-based defect-tracking and technical-support system adds the following: integration with version-control systems, which lets you keep track of the changes you make to source, design, and documentation files; enhanced reporting and analyzing features, which let you link Track's database with multiple external databases, link a defect database to a customer or project database, and import test results generated by automated testing tools; and support for Microsoft Mail and cc:Mail. \$495.

Contact: Soffront Software, Milpitas, CA, (408) 263-2703; [info@soffront.com](mailto:info@soffront.com).

Circle 1024 on Inquiry Card.

**Hi-Res 5.0**, an SDK for Windows that provides for fractal still-image compression and decompression, offers compression ratios from 3-to-1 to 250-to-1; faster decompression rates; smaller file sizes for compressed images, which lets you place more images on a CD-ROM or other storage medium; improved resolution independence, allowing an almost unlimited number of zooming levels; color mapping; and cross-platform support for Windows 3.1, Windows 95, Windows NT, Macs, and the PowerPC. The package is available in two versions: Hi-Res Professional 32 (\$8995) and Hi-Res Standard 32 (\$2995).

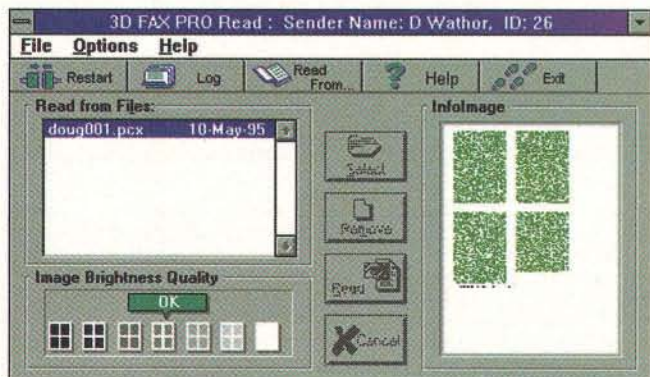
Contact: Iterated Systems, Norcross, GA, (404) 840-0310; 73443.1674@compuserve.com.

Circle 1023 on Inquiry Card.

**RightFax for Windows NT** is 32-bit multitasking and multithreaded LAN fax-server software that allows workstations on a Windows NT network to send and receive faxes. Server license for a single channel with unlimited users, \$1995.

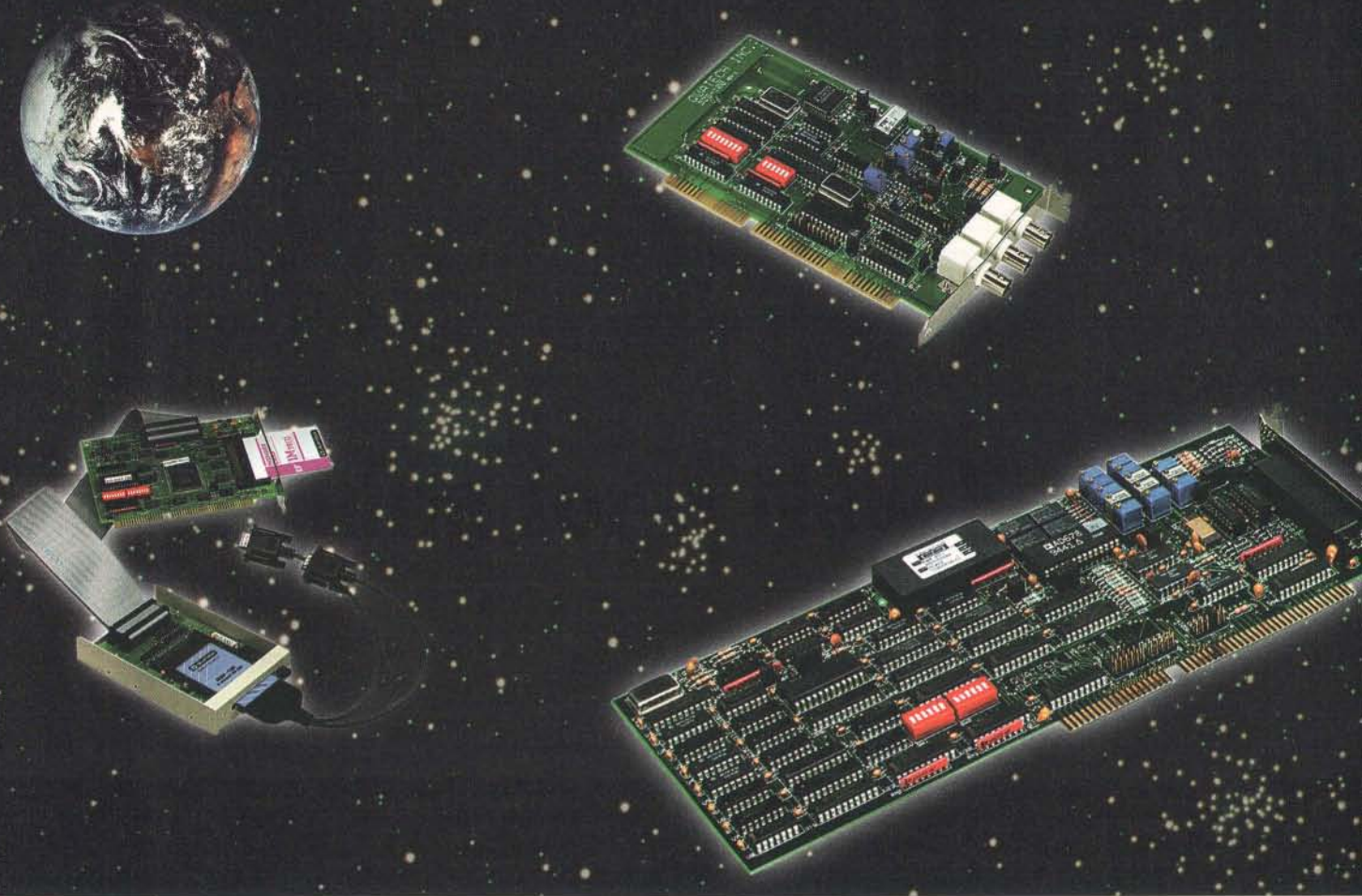
Contact: RightFax, Tucson, AZ, (602) 327-1357.

Circle 1017 on Inquiry Card.





# Reaching for a New Frontier



Having trouble keeping up with the ever-changing world of technology? Quatech can help. We are committed to providing our customers with quality products and exceptional service and support. We manufacture a complete line of communication and data acquisition products for PC/XT, PC/AT, PS/2, and PCMCIA systems. Just tell us your application, and we'll find the solution that's right for you.

Quatech's communication and data acquisition PCMCIA cards provide maximum flexibility for your application. Communication PC cards include single and dual channel RS-232 and RS-422/485, EPP, and synchronous adapters. Data acquisition PC cards provide 12 and 16-bit analog input, 8 channel analog output, and 24 digital I/O. Add PCMCIA capability to your desktop computer with our Internal Interface Adapters. Each adapter supports Type I, II and III PC cards, and is available in several configurations.

Communication boards for ISA and Micro Channel meet synchronous, asynchronous, serial, and parallel communication requirements with protocols such as RS-232, RS-422, RS-485, Current Loop, and IEEE-488. Intelligent and coprocessor adapters are also available. Data acquisition products add analog to digital, digital to analog conversions, and digital I/O capabilities in 8 to 16-bit resolution. Other boards provide the capabilities for digital multimeters, digital frequency synthesizers, arbitrary waveform synthesizers, and IEEE-488 GPIB interfaces.



*Foreign Distributor Inquiries Welcome*

**For more information and a free 1995 Handbook, call a Quatech sales representative today at 800-553-1170.**

**Quatech, Inc.** 662 Wolf Ledges Parkway, Akron, OH 44311. **International Distributors:** **Australia**/Interworld Electronics & Computer 61-3-9563-5011, **Austria**/Megadata 43-1-523 42 12, **Belgium**/Acal NV/SA 32-27-205983, **Brazil** (Sao Paulo)/Intercomp 55-11-8532733, **Brazil** (Rio de Janeiro)/Medusa Sistemas e Automacao 55-21-2554745, **Canada**(Western)/Interworld Electronics 800-663-6001(Toronto office 800-465-0164), **China**/Quatech China 86-1-205-9030, **Denmark**/Jes Rasmussen ApS. 45-4281-6838, **Finland**/Lab Hi-Tech OY 358-0-682-1255, **France**/Elexo 33-1-69537020, **Germany**/Jupiter Electronic Systems GMBH 49-61-8175041, **Hong Kong**/Brio Technology Ltd. 852-581-1111, **India**/Comsquare Network Pvt. Ltd. 91-11-224-5159, **Israel**/Milivision Ltd. Div. 972-9-500623, **Italy**(Non-PCMCIA)/N.C.S. Computer Italia 39-331-770016, **Italy**(PCMCIA Only)/Kernel Consulting S.r.l. 39-6-77207000, **Japan**/Nictrix Corp. (New Jersey) 201-947-2220, **Korea**/Sam Boo Systems 82-2-5384001, **Netherlands**/ACAL Auriema 31-40-502602, **New Zealand**/Advanced Portable Technologies 64-4-3852838, **Pakistan**/Rastek (PVT) Limited 92-21-4551881, **Saudi Arabia**/Integrated Computer Operations 966-3-895-1827, **Singapore**/Bliss Services Pte Ltd. 65-338-1300, **South Africa**/Eagle Technology 27-21-234943, **Spain**/Santa Barbara SA 34-3-418-81-16, **Sweden**/Systec 46-13-310140, **Switzerland**/Technosoft 41-64-519040, **Turkey**/Logic Group 90-212-2747197. PC/XT, PC/AT, PS/2, and Micro Channel are registered trademarks of the IBM Corporation. All other trademarks are of their respective companies.





# **BYTE**

## **BUYER'S GUIDE**

**Essential Products  
and Services for  
Technology Experts**

### **Mail Order**

Top mail-order vendors offer the latest hardware and software products at the best prices.

**292**

### **Hardware/Software Showcase**

Your full-color guide to in-demand hardware and software products, categorized for quick access.

**309**

### **Buyer's Mart**

The BYTE classified directory of computer products and services, organized by subject so you can easily locate the right product.

**319**





# COMPUTER DISCOUNT WAREHOUSE™



## IBM® ThinkPad® 701C

- ✓ IntelDX4™ 75MHz CPU
- ✓ 8MB RAM, 24MB max.
- ✓ 540MB removable hard drive
- ✓ 10.4" active-matrix color display
- ✓ Local bus video with 1MB RAM
- ✓ PCMCIA: accepts 2) Type II or 1) Type III
- ✓ 14.4K bps fax/modem
- ✓ Full size expandable keyboard
- ✓ Keyboard-integrated TrackPoint III™ pointing device
- ✓ Super NiCd battery
- ✓ Preloaded IBM-PC DOS™ V6.3, Windows® V3.11 and IBM OS/2 Warp V3.0
- ✓ 3 year international warranty
- ✓ Lightweight and compact: 4.5 lbs, 9.7" x 7.9" x 1.7"



Butterfly Keyboard

## WHY PAY RETAIL?

## CDW® Sells For Less

Price Drop! **\$4599.00** CDW 51793



## 28,800bps PCMCIA Fax Modem with XJACK®

V.34!

- ◆ Data: V.34 (28.8K bps) and V.32bis (14.4K bps)
- ◆ Fax: 14.4K bps send/receive
- ◆ Flash ROM field upgradeable
- ◆ Auto installation and configuration
- ◆ Hot swappable
- ◆ Includes data/fax software for Windows®
- ◆ Five-year warranty and unlimited free technical support from Megahertz

28.8K with XJACK.....**\$299.78** CDW 46849

14.4K with XJACK.....**\$198.89** CDW 37757

## HARDWARE, SOFTWARE & PERIPHERALS AT DISCOUNT PRICES

### NETWORKING PRODUCTS

#### NOVELL

##### Netware V4.1

5 User CD	669.72
10 User CD	1519.89
25 User CD	2244.74
50 User CD	3028.97
100 User CD	4229.98

##### Netware V3.12

5 User 3.5"	619.93
10 User 3.5"	1409.77
25 User 3.5"	2082.50
50 User 3.5"	2809.96
100 User 3.5"	3925.82

Call for Pricing on Novell NetWare upgrades!

#### 3Com

3C503 Etherlink II coax	159.44
3C509B Etherlink III coax	114.14
3C509B Etherlink III coax 5pk	479.65
3C509B Etherlink III 10BT	111.14
3C509B Etherlink III 10BT 5pk	442.36
3C509B Etherlink III combo	123.77
3C509B Etherlink III combo 5pk	524.78
3C579 Etherlink EISA coax	229.91
3C579 Etherlink EISA 10BT	229.91
3C1627 12 port Linkbuilder 10BT	619.44

#### ARTISOFT

NodeRunner 2000A	215.58
NodeRunner 2000T	169.05
NodeRunner 2000C	169.05
NodeRunner/SI 2000A	87.13
NodeRunner/SI 2000T	72.82
LANtastic V6.0	79.50
LANtastic V6.0 5 user	329.67
LANtastic V6.0 Starter Kit	72.82
Central Station II	393.13
Simply LANtastic starter kit	193.79
T-Runner 8 port 10BT	179.99
T-Runner 12 port 10BT	199.82



Multiprotocol print server 10BT HP MIO	249.93
Multiprotocol print server 10BT pocket	309.61
Multiprotocol 2 printer server combo	309.61
Multiprotocol 4 printer server combo	499.62
SNAP starter kit 2 computers, 1 printer	119.10
SNAP add-on transmitter	49.50
Fax Authority Solo network fax server	499.86

#### IBM

Token Ring Adapter II 16/4 ISA	399.88
Token Ring Auto Adapter 16/4 ISA	257.76
IBM Token Ring MAU	998.42

#### intel

EtherExpress PRO/100Mbps PCI	219.19
EtherExpress PRO/100Mbps EISA	246.52
EtherExpress PRO/100Mbps PCI 5pk	968.36
EtherExpress PRO/100Mbps PCI 5pk	109.01
EtherExpress PRO/100Mbps PCI 5pk	419.98
EtherExpress PRO/100Mbps PCI 5pk	115.07
EtherExpress PRO/100Mbps PCI 5pk	472.00
EtherExpress 16 coax	99.33
EtherExpress 16 coax 5pk	454.13
EtherExpress 16 10BT	99.33
EtherExpress 16 10BT 5pk	469.50
EtherExpress 16 10BT 20pk	1698.38
EtherExpress MCA 10BT	166.52
EtherExpress 16 combo	116.77
EtherExpress 16 combo 5pk	549.72
EtherExpress Flash 10BT	111.88
EtherExpress Flash 10BT 5pk	519.90
EtherExpress Flash 10BT 5pk	129.79
EtherExpress Flash 10BT 5pk	591.05
TokenExpress 16/4	328.96
NetPortExpress II 10BT	368.85

#### MICRODYNE

Eagle NE2000+ coax	76.83
Eagle NE2000+ 10BT	69.45
Eagle NE2000+ combo	469.40
IRMAtrac 4/16Mbps ISA Convertible	439.30
IRMAtrac 4/16Mbps ISA Hardtop	289.23

### NETWORKING PRODUCTS

#### SMC

EtherEZ 10BT	94.47
EtherEZ coax	94.47
EtherEZ combo	107.09
Etherpower 10BT PCI	142.32
Etherpower2 PCI	155.31
Etherpower2 10BT	252.26
Etherpower2 combo	271.08
Ultra16 Ethernet coax	94.96
Ultra16 coax 5pk	509.88
Ultra16 Ethernet 10BT	96.10
Ultra16 10BT 5pk	459.23
Ultra16 10BT 24pk	1573.71
Ultra16 Ethernet combo	107.71
Ultra16 combo 5pk	559.15
TigerHub TP8 6 port + AUI	169.78
TigerHub TP8 6 port + BNC	189.83
TigerHub TP12 12 port + AUI	379.79
3508 Ethernet 8 port hub 10BT	298.83
3512 Ethernet 12+2 port hub 10BT	548.55
PC600WS ARCNET coax	119.93
ARCNET 8 port active hub coax	229.41
TokenCard Elite 16/4	229.82

#### THOMAS & MORGAN

TC5143 Ethernet 10BT	72.89
TC5143 Ethernet 10BT 6pk	399.94
TC8242 ARCNET 8-bit coax	66.86
TC8245 ARCNET coax	179.99
TC5055 Ethernet 8 port hub 10BT	298.83
TC4045 Token Ring 16/4	226.54

CDW Carries the Complete Line of TCNS Products. Call for Details!

#### TERMINALS

Link MC5 amber/green/white	289.77
Link MC80 14" color	419.50
Wyse 55 amber/green/white	223.21
Wyse 60 amber/green/white	279.60
Wyse 160 amber/green/white	329.88

#### Xircom

PE310BC pocket Ethernet coax	317.26
PE310B2 pocket Ethernet coax	277.51
PE310BT pocket Ethernet 10BT	277.51
PT316CTP pocket Token Ring III	475.83
PPX03 Parallel port multiplexer	77.90
PS-CE2 PCMCIA Ethernet 10BT	158.69
PS-CE2 PCMCIA Ethernet combo	206.15
PS-CE2 PCMCIA Token Ring	409.94

### TAPE & REMOVABLE MEDIA DRIVES

#### COLORADO MEMORY SYSTEMS INC.

Jumbo 350 internal	139.67
Jumbo 700 internal	199.88
Jumbo 1400 internal	309.48
Trakker 250 parallel port	268.77
Trakker 350 parallel port	284.91
Trakker 700 parallel port	337.47
T1000 800MB Travan	195.38
PowerTape 2.4GB SCSI internal	937.58
PowerTape 2.4GB SCSI external	1077.99

#### iomega

Zip drive 100MB parallel interface	199.00
Zip drive 100MB SCSI interface	199.00
Zip disks 100MB, 3pk	49.95
Ditto 420MB tape drive internal	99.00
Ditto 850MB tape drive internal	199.00

#### MICROSOLUTIONS

Backuppak 3.5" 1.44MB floppy parallel	146.32
Backuppak 5.25" 1.2MB floppy parallel	158.28
Backuppak 250MB tape backup parallel	259.65

### TAPE & REMOVABLE MEDIA DRIVES

#### CONNER

Tape'Stor 250MB internal	119.28
Tape'Stor 420MB internal	158.19
Tape'Stor 420MB parallel	309.48
Tape'Stor 800MB Travan internal	238.63
Tape'Stor 800MB Travan parallel	392.73
Tape'Stor 850MB internal	219.87
Tape'Stor 850MB parallel	365.25
Tape'Stor 4GB internal IDE	539.78

#### Mountain

FS8500 305MB IDE internal	313.53
SideCar II 305MB parallel	309.44
1200-4 4GB SCSI external	1634.49

### MULTIMEDIA AND CD-ROM

#### Creative Labs

Digital School House CD 2X kit internal	219.98
Sound Blaster Discovery 16 2x kit	277.11
Multimedia Home CD 4x kit internal	449.99
SoundBlaster value edition	46.37
Sound Blaster 16 value edition (IDE)	99.89
SoundBlaster 16 MCD	139.25
SoundBlaster 16 SCSI-2	179.95
SoundBlaster 16 ASP MCD	174.50
SoundBlaster 16 ASP SCSI-2	186.99
SoundBlaster AWE32 value edition	166.98
SoundBlaster AWE32	299.99

Microsolutions 4X CD parallel w/sound	488.15
Advent PP570 speakers 35W	245.97
Advent PE222 speakers/subwoofer	188.64
Diamond 4000 Quad CD kit internal	299.71
Diamond 5000 Quad CD kit internal	389.82
Jensen JPS35 speakers SW	54.86
Jensen JPS45 speakers 10W	89.93
Logitech SoundMan Wave	119.49
Microsolutions 4X CD parallel	354.88
NEC 2V	139.56
NEC 2V Deluxe	285.69
NEC 3X Plus Kit	394.54
NEC 3X Plus Kit	458.93
NEC 6Xi	456.14
NEC 6Xi	547.55
Pioneer DPM624X 6 disc 4X changer	671.51
Pioneer DPM624X 18 disc 4X changer	1879.28
Plextor 4plex quad external	559.85
Plextor 4plex quad internal	419.79
Plextor 6X internal	499.87
Sigma Designs RealMagic Lite	258.59
Sigma Designs RealMagic MPEG	368.53
Sigma Designs RealMagic CD Kit	635.81
Sony CDU-55S SCSI 2X internal	167.21
Sony 4X internal w/IDE interface	229.63
Sony 4X internal w/SCSI-2 interface	316.62
Teac SuperQuad 4X internal	204.52
Toshiba 3601 SCSI 4X internal	309.86
Turtle Beach Monte Carlo	84.71
Turtle Beach Tropez	193.67
Turtle Beach Monterey	316.94

### DIGITIZERS & SCANNERS

#### CalComp

DB III 12X12 4 button	299.67
DB III 12X12 16 button	299.97
DB III 12X12 pressure pen	389.97
Drawing Slate II 12X12 4 button cordless	228.98

### DIGITIZERS & SCANNERS

#### EPSON

ES-1200-ProPC	1295.72
---------------	---------

#### HEWLETT PACKARD

ScanJet 3P	319.57
ScanJet 3P document feeder	209.49
ScanJet 3C WISA interface	936.65
ScanJet IICX document feeder	468.50
ScanJet IICX transparency adapter	633.26

#### MICROTEK

Scanmaker IIG grayscale	249.29
Scanmaker IIG color	356.85
Scanmaker IISF color	495.32
Scanmaker IIHR color	749.98
Scanmaker III color	2409.95
Scanmaker 35T slide scanner	698.58

#### Summagraphics

Summagraphics III 12 X 12 16 button	218.58
Summagraphics III 18 X 12 4 button	488.33

### MONITORS

Mag Innovision DX15F	379.88
Mag Innovision DX17F	669.78
Mag Innovision MX17F	896.97
Mag Innovision MX21F	1689.47
Magnavox CM2089 14" 28	237.56
Magnavox CM2089 14" 28 NI	249.34
Magnavox CM2015 15" 1024	319.29
Magnavox CM4015 15" 1280	375.84
Magnavox CM4017 17" 31	609.25
Magnavox CM4018 17" 28	604.57
Magnavox 20CM64 20"	1069.44
NEC 3FGe 15"	409.75
NEC XV14 14"	311.83
NEC XV15 15"	433.03
NEC XV17 17"	756.43
NEC XV15 15"	575.77
NEC XV17 17"	998.26
NEC XE21 21"	1779.24
NEC XP15 15"	579.68
NEC XP17 17"	1095.36
NEC XP21 21"	2169.43
Samsung 3 14"	233.44
Samsung 15GL 15"	372.89
Samsung 17GLs 17"	859.82
Sony CPD-1425 14"	318.33
Sony 159F 15"	459.85
Sony 175F1 17"	879.48
Sony 20SE1 20"	1929.28
ViewSonic 15GS 15"	427.17
ViewSonic 17GS 17"	737.48
ViewSonic 21PS 21"	1693.70

### VIDEO BOARDS

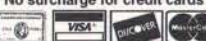
ADS VGA to TV Elite internal	134.89
ADS VGA to TV Elite external	198.83
ATI Graphics Xpression ISA 2MB	189.36
ATI Graphics Xpression VLB 2MB	189.36
ATI Graphics Xpression PCI 2MB	189.36
ATI Graphics Pro Turbo ISA 2MB	319.97
ATI Graphics Pro Turbo VLB 2MB	319.97
ATI Graphics Pro Turbo PCI 2MB	319.97
ATI Graphics Pro Turbo PCI 4MB	449.68
Diamond Stealth 64 VLB 2MB VRAM	95.09
Diamond Stealth 64 PCI 2MB VRAM	199.00
Diamond Stealth 64 VLB 2MB VRAM	316.64
Diamond Stealth 64 PCI 2MB VRAM	316.64
Hercules Dynamite Pro ISA 1MB	147.84
Hercules Dynamite Power VLB 1MB	189.80
Hercules Dynamite Power VLB 1MB	144.77
Hercules Dynamite Power VLB 2MB	198.29
Hercules Terminator 64 PCI 2MB	315.30
Hercules Terminator 64 PCI 2MB	315.30
Intel Smart Video Recorder Pro	398.99

If You Find a Better Price, Call CDW® Before You Buy (800) 959-4CDW



BUY WITH CONFIDENCE CDW® IS A NASDAQ TRADED COMPANY  
TICKER SYMBOL: CDWC  
D & B 5A1  
Duns 10-762-7952

No surcharge for credit cards



Credit Card charges are not submitted until time of shipment. Freight is calculated on the carrier's actual freight charge plus insurance and packaging. The cost of insurance is 0.25% (to 0.50%) of the order total. Packaging materials will not exceed \$5.00 per package or \$50.00 per order. Packaging alignment: For your protection, we ship only to your verified billing address. Non-delivery returns added to returning fee. Allow 10 business days for shipping when ordered by personal check. Software, chips and other electronic components are not returnable. All pricing subject to change. © Trademarks of all companies listed in this ad. Not responsible for typographical errors.

### CDW® TELEPHONE HOURS

Sales 7:00-9:00 CDT Mon-Fri.  
9:00-5:00 CDT Sat.  
Tech Support for Customers  
8:00-7:00 CDT Mon-Fri.  
9:00-5:00 CDT Sat.

### MOST ORDERS SHIP THE SAME DAY



# COMPUTER DISCOUNT WAREHOUSE™



## EPSON

### Stylus Color II High resolution color inkjet printer

- Resolution: 360 x 360 dpi
- Maximum print speed: 2.5 ppm
- Fonts: 4 scalable, 3 LQ
- Paper capacity: 100 sheets
- Paper types: plain paper, labels, envelopes, transparencies, Epson 360, 720 and high quality glossy
- Paper sizes: letter, legal, A4, B5, statement, executive
- Maximum print area: 8.03" x 10.34" (letter)
- Parallel interface
- 2 year warranty

NEW!



CALL!

## WHY SETTLE FOR LESS?

## CDW® SERVICES YOU BETTER

## NEC

NEW!

### MultiSpin 6X Series

- 145ms access, 900KB/sec data transfer rate
- 256KB buffer for smooth audio/video playback
- Internal (6X) or external (6Xe) form factor
- Rotating anti-dust door
- Front panel controls and backlit LCD status display
- Multisession PhotoCD compatible
- SCSI-2 interface (host adapter sold separately)



6Xi	\$456.14	CDW 53460
6Xe	\$547.55	CDW 53461

CDW® CARRIES OVER 20,000 PRODUCTS. IF YOU DON'T SEE IT, **CALL!**

### COMPUTERS

#### TOSHIBA

T2100 DX2/50 250MB mono	1258.33
T2100CS DX2/50 330MB dual color	1799.82
T2100CT DX2/50 330MB act color	2438.54
T2100CS DX4/75 350MB pas color	1999.85
T2130CS DX4/75 520MB act color	2524.52
T2130CT DX4/75 520MB pas color	3036.59
T2130CS DX4/75 520MB pas color CD	1966.16
T2150CT DX4/75 500MB act color CD	3669.85
T2400CS 320MB dual color	1899.00
T2400CT 320MB act color	2529.43
T2400CT 320MB act color	2597.87
T2450CT 320MB act color	3108.10
T2450CT 500MB act color	3198.17
T2450CT 500MB act color	3186.29
T4850CT DX4/75 520MB act color	3288.67
Portege 610CT 5/90 720MB act color	4338.05
400C 5/75 810MB dual color	3896.15
400CCT 5/75 810MB act color CD	4819.73
T4900CT 5/75 772MB act color	4397.33

#### AST

Ascentia 910N 4/50 340MB pas color	2459.73
Ascentia 910N 4/75 510MB pas color	2849.50
Ascentia 910N 4/75 510MB act color	3879.81
Ascentia 910N 4/75 510MB act color	3965.22
Ascentia 950N 5/75 500MB dual color	3348.81
Ascentia 950N 5/75 800MB dual color	3636.46
Ascentia 950N 5/75 800MB act color	4719.13
Ascentia 950N 5/75 1.2GB act color	5162.24
Advantagel 6066 4/66 540MB CD	1019.62
Advantagel 8075 5/75 1GB CD	1843.13
Advantagel 8100 5/100 1GB CD	2519.33

#### IBM

##### ThinkPad portables

360CE DX2/50 340MB act color	3099.00
360CE DX2/50 540MB act color	3449.00
701CS DX4/75 360MB act color	4299.00
701CS DX4/75 540MB act color	4599.00
701CS DX4/75 540MB pas color	3849.00
755CE DX4/100 540MB act color	5349.00
755CE DX4/100 810MB act color	5799.00
755CD DX4/100 540MB act color CD	5349.00
755CD DX4/100 810MB act color CD	5799.00
755CX 5/75 540MB act color	5849.00
755CX 5/75 810MB act color	6999.00

#### Apiva

Apiva 535 DX2/66 540MB	1349.00
------------------------	---------

#### PC300 Series desktops

PC300 5/75 8MB, 540MB	1812.26
PC300 5/90 16MB, 850MB	2291.26
PC350 5/75 8MB, 540MB	1679.00
PC350 5/75 16MB, 850MB	2239.00
PC350 5/90 16MB, 850MB	2743.00
PC750 5/90 16MB, 540MB	2961.00
PC750 5/90 16MB, 540MB, CD	3565.00

#### NEC

Versa V DX2/50 250MB dual cfr	2149.87
Versa V DX2/50 250MB act cfr	2296.63
Versa V DX2/50 340MB act cfr	2389.81
Versa V DX2/50 540MB act cfr	2678.65
Versa 2000C 4/75 4MB, 350MB dual cfr	1819.84
Versa 2000C 4/75 4MB, 350MB act cfr	2257.17
Versa 2000C 4/75 8MB, 350MB act cfr	2489.73
Versa 2000C 4/75 8MB, 540MB act cfr	2678.82
Versa M DX4/75 340MB true cfr	2846.67
Versa M DX4/75 540MB hi-res cfr	3337.49
Versa M DX4/100 540MB hi-res cfr	3639.55
Versa M DX4/100 540MB true cfr	3426.27
Versa M DX4/100 810MB hi-res cfr	4349.06
Versa P 5/75 540MB act cfr	4647.39
Versa P 5/75 540MB hi-res cfr	4619.83
Versa P 5/75 810MB act cfr	5029.69
Versa P 5/75 810MB 9.5" hi-res cfr	4998.58
Versa P 5/75 810MB 10.4" hi-res cfr	5349.62

#### TEXAS INSTRUMENTS

TM4000M DX4/75 455MB dual color	2499.78
TM4000M DX4/75 524MB act color	2848.00
TM4000M DX4/100 524MB act color	3529.84
TM5000 5/75 524MB dual color	3668.55
TM5000 5/75 810MB act color	4539.22
TM5000 5/90 1.2GB act color	CALL!

### DOT MATRIX & LASER PRINTERS

#### OKIDATA

184 Turbo	219.14
ML320	299.88
ML321	427.40
ML380	212.43
ML395	986.07
ML395C	1039.74
ML520	365.77
ML521	482.27
ML590	427.71
ML591	579.12
Pacemarker 3410	1213.35
OL400E	345.38
OL410E	539.89
OL410E/PS	759.86
OL810	904.98
OL810E	769.33
OL830 Plus	1076.51
OL1200	1115.89
OKIJET 2010	391.77

#### Canon

BJ30 mono	259.88
BUC70 color	358.65
BJ100	175.86
FX670	199.70
BJ230	391.55
BUC600e color	471.99
BUC4000 720dpi + color	348.78

#### EPSON

AP2250	36.64
AP3250	148.45
AP3260	167.82
LX300	174.32
FX670	300.95
FX1170	405.23
LQ1070+	409.64
LQ870	454.44
LQ1170	585.85
LO2550	985.08
DFX5000 Plus	1529.29
DFX8000	2559.89
Stylus 300	163.16
Stylus 800+	215.47
Stylus 1000	479.34
Stylus Color	526.53
ActionLaser 1100	383.62
ActionLaser 1400	495.53

#### LEXMARK LASER PRINTERS

WinWriter 400 laser	755.03
WinWriter 600 laser	999.00
ValueWriter 300 (4037 SE 5PPM)	844.87
ValueWriter 600 laser	815.87
4039 10 Plus 10ppm	1218.00
Optra R 12ppm	1423.63
Optra Rx 16ppm	1980.33
ExecJet IIc	293.76

#### Panasonic

1150	133.49
2023	182.27
2130	204.40
2135 Color	247.43
3123	249.00
4400 Laser	454.90
5400 Laser	388.55
KX-SP100 printer/fax/copier	776.54

#### TEXAS INSTRUMENTS

microLaser 600	865.10
microLaser Pro 600 PS23	1197.02
microLaser Pro E	1395.49
microLaser Power Pro 600 PS85	1599.76

#### HEWLETT PACKARD

OfficeJet Inkjet fax/copier/printer	699.55
DeskJet 540	219.49
DeskJet 660C	489.76
DeskJet 1600C	1369.07
DeskJet 1600CM	1992.48
LaserJet SP	899.77
LaserJet 4 plus	1449.95
LaserJet 4SL	2998.55
LaserJet 4V	1967.38
LaserJet Color	5929.62

#### COSTAR

LabelWriter XL Win	139.86
LabelWriter XL Plus Win	224.89

### HARD DRIVES & CONTROLLERS

#### Maxtor

270MB Fast-ATA	151.66
345MB SCSI-2	174.21
425MB Fast-ATA	155.76
540MB Fast-ATA	185.85

#### MICROPOLIS

4221 2GB SCSI-2	965.18
1936 3GB SCSI-2	958.89
3243 4.3GB SCSI-2	1499.87

#### CONNER

425MB IDE	164.32
540MB IDE	209.40
850MB Fast-ATA	255.09
1.27GB Fast-ATA	373.31

All Conner drives listed include complete installation hardware and software.

#### Seagate

428MB Fast-ATA	158.10
545MB Fast-ATA	187.74
855MB Fast-ATA2	241.72
1GB Fast-ATA2	288.59
1GB SCSI-2	495.32

#### WESTERN DIGITAL

Caviar 540MB EIDE	189.35
Caviar 730MB EIDE	218.24
Caviar 1.2GB EIDE	325.80

#### CONTROLLERS

Accugolic SIDE-3+ w/on-board BIOS	49.90
Accugolic SIDE-4+ w/pwr, 2ser, game	35.06
Accugolic SIDE-4VL EIDE, 16550 serial	89.76
Accugolic ISAPort SCSI-2	126.49
Adaptec AVA1505 SCSI-2 CD Kit	54.95
Adaptec AHA1542CF SCSI-2	265.45
Adaptec AVA2825 VLB SCSI-2/EIDE	166.87
Adaptec 2842 VLB SCSI-2	249.83
Promise 2300+ EIDE VLB	59.87

### MODEMS & COMMUNICATIONS

#### Robotics

##### SPORTSTER MODEMS

V.34 28.8K internal w/fax	189.88
V.34 28.8K external w/fax	204.86
Vi 28.8K internal w/fax & voice	208.70
Vi 28.8K external w/fax & voice	225.33
14.4K internal w/fax	94.81
14.4K external w/fax	111.00
Vi 14.4K internal w/fax & voice	113.59
Vi 14.4K external w/fax & voice	133.78

##### COURIER MODEMS

V.34 internal w/fax	387.80
V.34 external w/fax	422.32

#### Hayes

ACCURA 144 internal w/fax	51.87
ACCURA 144 external w/fax	111.18
ACCURA 288 V.34 internal w/fax	183.76
ACCURA 288 V.34 external w/fax	218.88
OPTIMA 144 external w/fax	374.30
OPTIMA 144 pocket w/fax	312.59
OPTIMA 288 V.34 internal w/fax	365.14
OPTIMA 288 V.34 external w/fax	419.44

#### PRACTICAL PERIPHERALS

14.4 internal w/fax	73.85
14.4 Mini Tower w/fax	92.76
V.34 28.8 internal w/fax	196.59
V.34 28.8 Mini Tower w/fax	209.64
Practical Pro Series	CALL!

#### BOCA

Online Express 14.4 internal w/fax	64.25
Online Express 14.4 external w/fax	79.78
V.34 28.8 internal w/fax	159.00
V.34 28.8 external w/fax	205.00

#### MICROCOM

Deskports ES 14.4	146.39
Deskports Fast ES V.34 28.8	179.54
Deskports Fast EP V.34 28.8	239.99

### BATTERY BACKUP AND UPS

#### American Power Conversion

BackUPS 280	99.53
BackUPS 400	144.28
BackUPS 450	175.01
BackUPS 600	243.00
BackUPS 900	345.76
BackUPS 1250	449.29
SmartUPS 400	299.89
SmartUPS 600	363.38
SmartUPS 900	514.61
SmartUPS 1250	644.24
SurgeArrest Network	34.25
SurgeArrest Pro	29.45
SurgeArrest Network + Phone	49.98
Line-R 600	119.09

#### Tripp Lite

BC250	94.97
BC PERS 420	138.91
BC PRO 550	188.16
BC PERS 500	173.09
BC PRO 675	231.43
BC PRO 850	269.03
BC PRO 1050	327.59
BC PRO 1400	426.10

#### SMART UPS SERIES NEW

SMART 280 LAN	218.30
SMART 450 LAN	273.94
SMART 675 LAN	399.87
SMART 850 LAN	389.74
SMART 1050 LAN	455.07
SMART 1400 LAN	569.41
Isobar 4 OUTLET	38.95
Isobar 6 OUTLET	46.38

#### PCMCIA CARDS

3Com Etherlink IIIB combo	213.38
Adaptec APT1460 SCSI-2	209.69
Hayes EZJack 14.4 w/fax	169.75
Hayes EZJack V.34 w/fax	299.87
IBM Token Ring 16/4	399.97
Linksys Ethernet combo	167.56
Megahertz 14.4K data/fax	179.48
Megahertz X-Jack 14.4 data/fax	169.55
Megahertz X-Jack Gold 14.4 data/fax	198.89
Megahertz V.34 X-Jack data/fax	299.76
New Media Wave Toaster SCSI-2 host	197.92
New Media Wave Jammer sound card	229.48
New Media Multimedia Combo	439.80
Simple Tech 14.4K data/fax modem	145.51
Simple Tech 14.4K modem + voice	143.07
Simple Tech Ethernet 10BT adapter	19.16
Simple Tech SCSI adapter	163.68
Simple Tech 33MB hard drive	359.88
Simple Tech 170MB hard drive	38.95
SMC Elite Ethernet 10BT	126.13
SMC Elite Ethernet combo	173.77
Turtle Beach Audio Advantage	119.98
USR Sportster 14.4K	178.99
USR Sportster V.34	319.40
Xircrom Ethernet coax	79.00
Xircrom Ethernet 10BT	158.69
Xircrom Ethernet combo	206.15
Xircrom Ethernet+modem 10BT	219.67
Xircrom Ethernet+modem combo	416.87







# HARD DISK EXCHANGE

BUY, SELL OR UPGRADE  
YOUR HARD DISK & PC

(714) 505-3157

Int'l Orders / Tech Assistance Inquiries

UNIVERSITY, SCHOOLS,  
GOVERNMENT &  
CORPORATE P.O.'S WELCOME



## HARD DISK PRICES SLASHED



IDE	ESDI	MFM/RLL
40MB ..... \$69	Micropolis 1355 ..... \$125 ✓	ST-225 20MB ..... \$39 ✓
65MB ..... \$89 ✓	Micropolis 1558 ..... \$199	ST-251 40MB ..... \$79
120MB ..... \$109	XT-4380E ..... \$179	ST-151 40MB ..... \$129
210MB ..... \$149	XT-8760E ..... \$399 ✓	ST-4096 80MB ..... \$109 ✓
Maxtor, Seagate Available	ST-4766E ..... \$499	Priam-185 71MB ..... \$89 ✓
LOOKING FOR SOMETHING SPECIAL? ASK US!	Conner & Maxtor Available	ST-238R 32MB ..... \$89
		ST-277R 65MB ..... \$99
		XT-2190 145MB ..... \$299
		XT-1140 120MB ..... \$279

SCSI	COMPAQ
ST-225N ..... \$49	CP4021 ..... \$149
ST-277N ..... \$89	CP4041 ..... \$209
ST-4380N ..... \$179 ✓	CP2121 ..... \$179
	Quantum & WD Available

FOR "HARD-TO-FIND" HARD DISKS  
CALL JIM OR MANDY

## MOTHERBOARDS

CPU INCLUDED	
386 SX/40 .....	\$69
386 DX/40 .....	\$99
486 SLC-33 .....	\$69
486 DLX-40 .....	\$99
486 DX-33 .....	\$139
486 DX2/66 .....	\$159
486DX2/80 .....	\$179
Pentium 90 .....	\$499
Pentium 100 .....	\$599

### SPECIAL !!!

DX4-100MB with 256 Cache,  
Fan & CPU ..... \$239

## MULTI-MEDIA

CD-ROM - 2 Speed with Sound Blaster, Speakers .....	\$199
CD-ROM - 4 Speed with Sound Blaster, OEM Card, Titles .....	\$299

## MEMORY

256x9 .....	\$11.99
1x3 - 70 .....	\$36.99
4x3 - 70 .....	\$129.99
4MB - 72 Pins .....	\$149.99
8MB - 72 Pins .....	\$299.99
16MB - 72 Pins .....	\$499.99
32MB - 72 Pins .....	\$899

CALL FOR CURRENT PRICES

## NEW HARD DRIVES

IDE - 3.5"	2.5" Notebook Drives
540MB ..... \$169	40MB ..... \$79
850MB ..... \$199	65MB ..... \$89
1.26GB ..... \$279	120MB ..... \$159
	250MB ..... \$199
SCSI-II	340MB ..... \$299
540MB ..... \$239	540MB ..... \$399
1.08GB ..... \$499	810MB ..... \$599
2.10GB ..... \$999	
4.00GB ..... \$1499	SPECIAL
	240MB Maxtor ... \$199
WIDE SCSI-II	65MB ..... \$99
1.08GB ..... \$599	Math Co.
2.10GB ..... \$1099	387SX ..... \$29
4.10GB ..... \$1699	387DX ..... \$29

## CPU

486DX-33 .....	\$69
486DX2-66 .....	\$79
486DX2-80 .....	\$119
486DX4-100 .....	\$129
Pentium 90 .....	\$329
Pentium 100 .....	\$429

## DATA RECOVERY

By Experts  
UNIX, DOS, MAC, OS/2, NOVELL  
Almost 100% Success  
CALL FOR ESTIMATE  
No Recovery - No Charge  
Ask for Jim, Matt or Mandy

## Tape Back-Up Special

Trakker  
250MB  
**\$199**  
Limited  
Quantities  
Available

## CONTROLLERS, ETC.

MFM 8/16 .....	\$29
IDE 16 Bit .....	\$19
IDE 8 Bit .....	\$49
SCSI 8 Bit .....	\$39
SCSI 16 Bit .....	\$89
ESDI 16 Bit (300MB) .....	\$49
ESDI 16 Bit (1GB) .....	\$149
Adaptec 1542 .....	\$219
Adaptec 2940 .....	\$239
IDE VLB .....	\$29

## SRAM/CACHE MEMORY

32K x 8, 64K x 8 &  
128K x 8 ..... CALL!

## FLOPPY DISK DRIVES

1.2 .....	Call for current price
1.44 .....	Call for current price

## BRACKETS / FRAME KITS

Floppy Bracket .....	\$25
Hard Disk Bracket .....	\$10
2.5" to 3.5" Conversion .....	\$29

**DEMO  
NOTEBOOK  
\$399**

## MONITOR - .28DP

14" - 1024x768

**\$179**

**WE BUY**  
MEMORY SIMMS & HARD DISKS  
Call Perry, Mandy or Matt  
(714) 505-3157

## IBM PS-1, PS-2 THINKPAD VALUE POINT CORNER

Ask for Jim Bullitt

PS-2 MODEL	35SX - 40SX
25 & 30 Hard Drives	40/80 139/179
20MB .....	340MB ..... \$249
30MB ..... \$125	1GB ..... \$539
40MB ..... \$149	
80MB ..... \$199	50,70 Series
340MB ..... \$249	30MB ..... \$79
1GB ..... \$539	60MB ..... \$199
	420MB ..... \$299
	1GB ..... \$599

## THINKPAD DRIVES

Model 360/750/788

340MB ..... \$399	THINKPAD MEMORY
540MB ..... \$499	4MB ... Call for price
710MB ..... \$649	8MB ... Call for price
810MB ..... \$699	

Ask for prices  
on PS1 & PS2  
Floppy Drives.

Value Point Memory	
4MB ..... \$159	
8MB ..... \$315	
16MB ..... \$579	

For Customer Service Call between  
11:00 a.m. to 3:00 p.m. PST  
at (714) 505-3831

DEMO PC COMPUTERS

### 486DX2/66

4MB, 256K Cache,  
MiniTower, DX2/66 CPU  
w/Cooling Fan,  
256K VGA Card, 540MB HD  
101 Keyboard

**\$599**

### 486SLC/33

2MB RAM, IDE / IO  
MiniTower, 1.44 FDD  
200MB HD,  
256K VGA Card  
101 Keyboard

**\$359**

### 486DX4/100

4MB, 256K Cache,  
MiniTower,  
DX4/100  
CPU w/Cooling Fan,  
1.2GB HDD, 2S/1P Ports  
256K VGA Card,  
101 Keyboard

**\$799**

### PENTIUM 100

#### SPECIAL

MiniTower, Pentium 100 CPU  
w/Cooling Fan, 8MB RAM,  
PC/IDE Controller, 1.44 FDD  
1.2GB, 2S/1P Port,  
1MB Super VGA  
101 Keyboard

#### SUPER PRICE

**\$1299**

### DX2/80

#### Super Special

MiniTower, Motherboard  
CPU w/Cooling Fan,  
IDE/IO, 1.44 FDD  
101 Keyboard

**\$299**

### DX4/100

#### Hi Tech Special

MiniTower, Motherboard  
CPU w/Cooling Fan,  
256K Cache, 250 Watt  
Power Supply

**\$299**

Talk to Our  
System Specialists  
Matt or Mandy  
for your  
Custom-Made Systems

800-801-9400

Call Toll Free for Orders Only

**ASHTEK INC.**

2600-B WALNUT AVE., TUSTIN, CA 92680

THESE ARE CASH PRICES & SUBJECT TO CHANGE WITHOUT NOTICE.

SHIPPING BY FEDERAL EXPRESS AND U.P.S. C.O.D. - (There is a 20% re-stocking charge.)

714-505-2693

FOR FAX ORDERS



Circle 135 on Inquiry Card.



# THE BEST BRAND DELIVERY

## TOSHIBA

**Pentium 75**  
**Built-in**  
**4X CD-ROM**

### Satellite Pro 400

- Built-in 4X CD-ROM Drive (Swap floppy and CD-ROM) (Active model only-optional on Dual Scan)
- Pentium 75MHz Processor
- Built-in 16-bit sound, microphone, speaker & MIDI
- 10.4" Active & Dual Scan
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use
- Lithium Ion battery technology
- Built-in infrared for no hassle printer connections

Processor	Screen	HD	Price
Pentium 75MHz	10.4" Dual Scan	772MB	\$3539
Pentium 75MHz	10.4" Active	772MB	4359



400

### Portégé 610CT

Processor	Screen	HD	Price
Pentium 90MHz	9.5" True Color	720MB	\$4359



Portégé 610CT

### Satellite T2110/T2130

- 10.4" Dual Scan & Active
- Built-in AC adapter - small, sleek design & reduced weight
- Integrated Accupoint - small, accurate & easy to use

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	330MB	\$1929
486DX4/75	10.4" Dual Scan	500MB	2459
486DX4/75	10.4" Active	500MB	3059



T2130

### Additional Toshiba Notebooks

Processor	Screen	HD	Price
<b>T4900CT</b>			
Pentium 75	10.4" Active	772MB	\$4799
<b>Satellite T2100</b>			
486DX2/50	9.5" Mono	250MB	\$1239
486DX2/50	10.4" Dual Scan	330MB	1789
486DX2/50	8.4" Active	330MB	2399
<b>Satellite T2150</b>			
486DX4/75	10.4" Dual Scan	500MB	\$2929
486DX4/75	10.4" Active	500MB	3699



T4900

## NEC

Processor	Screen	HD	Price
<b>Versa V</b>			
486DX2/50	9.5" Dual Scan	250MB	\$2129
486DX2/50	9.5" Dual Scan	340MB	2179
486DX2/50	9.5" Active	250MB	2269
486DX2/50	9.5" Active	340MB	2369
486DX2/50	9.5" Active	540MB	2649
486DX4/75	9.5" Active	340MB	2549
486DX4/75	9.5" Active	540MB	2739
486DX2/50	10.1" Active	340MB	2549
486DX4/75	10.1" Active	540MB	2929

<b>Versa M</b>			
486DX4/75	9.5" Dual Scan	340MB	\$2459
486DX4/75	9.5" Active	340MB	2739
486DX4/75	9.5" Active	540MB	3029
486DX4/75	9.5" High Res.	540MB	3199
486DX4/100	9.5" Active	340MB	3399
486DX4/100	9.5" Active	810MB	4069
486DX4/100	9.5" High Res.	540MB	3879
486DX4/100	9.5" High Res.	810MB	4249

<b>Versa P</b>			
Pentium 75	9.5" Active	540MB	\$4349
Pentium 75	9.5" Active	810MB	4729
Pentium 75	9.5" High Res.	540MB	4539
Pentium 75	9.5" High Res.	810MB	4899
Pentium 75	10.4" Active	540MB	4629
Pentium 75	10.4" Active	810MB	4999
Pentium 75	10.4" High Res.	810MB	5199



Versa 2000

### Versa 2000

- Lithium Ion battery technology
- VersaGlide touch-pad pointer - simple & accurate
- Built-in, upgradable 14.4 fax/modem (active models only)
- LOADS of **FREE** software preinstalled

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	350MB	\$1999
486DX4/75	9.5" Active	350MB	2299*
486DX4/75	9.5" Active	350MB	2599
486DX4/75	9.5" Active	540MB	2799

\*14.4 fax/modem not built-in

## TEXAS INSTRUMENTS

**TravelMate 4000M**  
Shown with  
Optional  
Docking  
Station



Call about  
Pentium 90  
TM5000  
Models



TravelMate 5000

### TravelMate 4000M

- **NEW!** 10.4" Active & 10.5" Dual Scan
- 16-bit sound card
- Integrated pointing device
- 2 Type II or 1 Type III PCMCIA slot

Processor	Screen	HD	Price
486DX4/75	10.5" Dual Scan	455MB	\$2459
486DX4/75	10.4" Active	525MB	2799
486DX4/100	10.4" Active	525MB	3479

**TM4000M**  
**CD-ROM Docking Station**  
**\$809.99**

### TravelMate 5000

- 75MHz Pentium with PCI Bus to optimize Pentium processor performance
- 10.4" Active Matrix display with 2MB Video RAM
- 10.5" Dual Scan display with 2MB Video RAM
- 65K colors on notebook display
- 16-bit Sound Card, Speaker, Microphone & MIDI
- Upgradable hard drive - easily add more storage
- Built-In Dual Lithium Ion Batteries
- Built-in infrared for no hassle printer connections

Processor	Screen	HD	Price
Pentium 75	10.4" Dual Scan	500MB	\$3899
Pentium 75	10.4" Active	772MB	4599

**ONLY at PCs COMPLEAT**

✓ **Lowest Price Guarantee**

✓ **30-Day Money Back Guarantee**

✓ **Free Tech Support**

✓ **Free Software Installation**

✓ **Free Configuration**



# ANDS, PRICE, & SERVICE

CALL  
for  
Guaranteed  
Lowest  
Price!

**PCs**  
**COMPLEAT**

800-298-4727

**AST**  
COMPUTER  
Authorized System  
Reseller



**75MHz  
Pentium**

**Ascentia 950N**



**Ascentia 910N**

## Ascentia 910N

- 10.4" Active & 10.3" Dual Scan
- Lithium Ion battery technology
- Intelligent power management to maximize performance
- Integrated Smartpoint - small, accurate & easy to use

Processor	Screen	HD	Price
486DX2/50	10.3" Dual Scan	340MB	\$2459
486DX4/75	10.3" Dual Scan	510MB	2649
486DX4/75	10.3" Dual Scan	700MB	2929
486DX4/75	10.4" Active	510MB	3689
486DX4/75	10.4" Active	700MB	3969

AST, AST logo are trademarks of AST Research, Inc. All rights reserved.

**IBM**

**ThinkPad® 701**  
as low as  
**\$3699**



**ThinkPad® 701**



**ThinkPad® 701**

## Additional IBM® Notebooks

Processor	Screen	HD	Price
<b>ThinkPad® 755</b>			
486DX4/100	10.4" Dual Scan	340MB	\$3499
486DX4/100	10.4" Dual Scan	540MB	3849
486DX4/100	10.4" Dual Scan	810MB	4299
486DX4/100	10.4" Active	340MB	4299
486DX4/100	10.4" Active	540MB	4649
486DX4/100	10.4" Active	810MB	5099
486DX4/100	10.4" Active	540MB	5649*
486DX4/100	10.4" Active	810MB	6099*
Pentium 75	10.4" Active	540MB	4749+
Pentium 75	10.4" Active	810MB	5199+
Pentium 75	10.4" Active	540MB	5799
Pentium 75	10.4" Active	810MB	6249
486DX4/100	10.4" Active LCD	540MB	6099
486DX4/100	10.4" Active LCD	540MB	7099*
486DX4/100	10.4" Active LCD	810MB	7549*

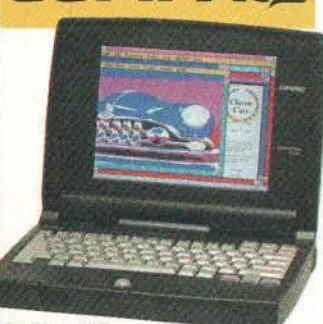
\*Features Built-In CD-ROM drive  
+ Does not include built-in audio, telephony & modem

## ThinkPad® 701

- Amazing pop-up, full-sized keyboard with jigsaw design
- 10.4" Active & Dual Scan
- Only 4.5 lbs. in subnotebook form factor
- 14.4 fax/modem, speaker phone, answering machine & voice mail
- Built-in 16-bit sound, microphone, speaker & MIDI
- Built-in infrared for no hassle printer connections
- 20 FREE software titles preinstalled

Processor	Screen	HD	Price
486DX2/50	10.4" Active	360MB	\$3699
486DX2/50	10.4" Active	540MB	4049
486DX4/75	10.4" Dual Scan	360MB	3549
486DX4/75	10.4" Dual Scan	540MB	3849
486DX4/75	10.4" Active	360MB	4299
486DX4/75	10.4" Active	540MB	4599

**COMPAQ**



**Contura 410**  
Product differs slightly from photo.

## Contura 420/430

- 10.4" Active & Dual Scan
- Fast 486DX4/75 or 486DX4/100 processors
- Optical trackball - smoother & more reliable
- High capacity drives - up to 720MB
- Compaq, 3-year worldwide warranty

Processor	Screen	HD	Price
486DX4/75	10.4" Dual Scan	420MB	\$2459
486DX4/75	10.4" Active	420MB	3029
486DX4/100	10.4" Dual Scan	720MB	2839
486DX4/100	10.4" Active	720MB	3499



**LTE Elite**

## LTE Elite

- 10.4" Active Matrix display
- Fast 486DX4/75 processor
- Built-in AC adapter - small, sleek design & reduced weight
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
486DX4/75	9.5" Dual Scan	340MB	\$2739
486DX4/75	9.5" Dual Scan	510MB	3119
486DX4/75	10.4" Active	510MB	4159
486DX4/75	10.4" Active	810MB	4539

B-9/95

**hp** HEWLETT®  
PACKARD



**HP OmniBook 600 Notebook PC**

## HP OmniBook 600

- Weights as little as 3.8 lbs.
- Built-in infrared for no hassle printer connections
- Instant "ON" ready-to-work state - lasts for months on a charge
- Built-in 16-bit sound, microphone & speaker

Processor	Screen	HD	Price
486DX2/50	8.5" Dual Scan	260MB	\$2549
486DX4/75	8.5" Dual Scan	260MB	3049
486DX4/75	9.5" Active	260MB	3649

**FREE HP COLOR KIT**  
With DeskJet 320 purchase.  
\$40 value  
While supplies last.

**Take Off  
with HP**  
**Save up to  
\$250!**

Call for details

## HP OmniBook 4000

- 10.4" Active & 10.3" Dual Scan
- Built-in 16-bit sound, microphone & speaker
- Replace floppy w/ 2nd battery for 5-7 hrs. battery life
- Up to 810MB drives available for high capacity storage

Processor	Screen	HD	Price
486DX4/75	10.4" Active	340MB	\$2819
486DX4/75	10.4" Active	520MB	3149
486DX4/75	10.4" Active	810MB	3459
486DX4/100	10.3" Dual Scan	340MB	2449
486DX4/100	10.3" Dual Scan	520MB	2659
486DX4/100	10.3" Dual Scan	810MB	2979
486DX4/100	10.4" Active	340MB	2899
486DX4/100	10.4" Active	520MB	3229
486DX4/100	10.4" Active	810MB	3599
486DX4/100	10.4" Active	810MB	4129*

\* 16MB RAM standard

**More Brand Names, peripherals and software  
available. If you don't see it, CALL!**

International 508-624-6400

Internet: sales@pcscmpleat.com

Open 24 Hours weekdays. 8am-8pm weekends and holidays.

**800-298-4727**



## IBM

<b>THINKPAD 360C</b> SX/33,4mb, 340mb disk, active color <b>\$:deal</b>	<b>THINKPAD 360CE</b> DX2/50,4/540mb, disk, active color <b>\$:2325</b>	<b>THINKPAD 755CS</b> DX4/75,4/540mb disk, passive color <b>\$ deal</b>
--	--	--

<b>THINKPAD 755C</b> DX4/75,4/810mb disk, active color <b>\$3699</b>	<b>755CX Pentium IN Stock</b>	<b>THINKPAD 755CSE</b> DX4/100,8/540mb disk, passive color <b>\$3599</b>
---	-------------------------------	---

<b>THINKPAD 755CE</b> DX4/100,8/810mb disk, active color <b>\$4799</b>	<b>THINKPAD 701C</b> DX4/75,8/540mb disk, active color <b>\$4450</b>	<b>THINKPAD 755CV</b> DX4/100,8/810mb disk, active color <b>\$5650</b>
---	---	---

<b>THINKPAD 755CD</b> DX4/100,8/540mb Active color display, CD rom drive, 1.44mb floppy drive <b>\$5399</b>	<b>THINKPAD 755CD</b> DX4/100,8/840mb Active color display, CD rom drive, 1.44mb floppy drive <b>\$ 5590</b>
---	--

## POWER PC THINKPAD

**Model 820 & 850**  
100MHz RISC PROCESSORS  
64-bit bus, 16/32mb ram,  
camer snap in, windows NT  
or AIX ready

CALL FOR  
SERVER 500  
SERVER 320  
PS/2 MODELS  
PC 300 & 700  
THINKPADS  
ADAPTERS  
SOFTWARE

**POWER PC DESKTOP**  
100MHz /120MHz/ 133MHz RISC  
PROCESSORS 64-bit bus, 16/32mb ram, windows NT or AIX  
ready **Call for Price**

## NOVELL

3.12/4.1	5 USERS.....499
3.12/4.1	10 USERS.....1075
3.12/4.1	25 USERS.....1565
3.12/4.1	50 USERS.....1980
3.12/4.1	100 USERS.....2580
3.12/4.1	250 USERS.....4560

stock  
stock  
ALL  
IN  
RED  
BOX

## TOSHIBA

T1910	486/33	4/200MB
T1910CS	486/33	4/200MB
T1960CS	DX2/50	200/340MB
T1960CT	DX2/50	200/340MB
T2400CS/CT	DX2/50	200/320MB
T4850CT	75MHZ	8/510MB
T4900CT	75MHZ	8/810MB
T2100	DX2/50	4/260MB
T2105 CS/CT	DX2/50	320MM
T2150CD	DX4/75	8/540MB
T2110CS	DX4/75	4/340MB
T2130CS/CT	DX4/75	8/520MB
T4000CDT	P/75	8/810MB
T4000CS	P/75	8/810MB

stock  
stock  
stock  
stock  
stock  
stock  
stock  
stock  
stock  
stock  
stock  
stock  
stock

**CALL FOR TOSHIBA B-STOCK**

## BRAND NAME

**LOW PRICES LEADER  
SINCE 1983**

We export with international warranty

## HEWLETT PACKARD

### Printers

D.JET 320...290  
HP 4+.....1349  
HP 4M+.....1835  
D.JET 660C.450  
D.JET 540...219  
HP4SIMX...4140  
HP 4SI.....2789  
HP4V.....1835  
HP 1200C...939  
Sscan 3C...880  
HP 4L.....489  
HP 5P.....935

### HP Vectra

VL3 Pentium  
P/75 8/840MB..1850  
P/90 8/840MB. 2250  
P/100 8/840MB..2399  
P/120 16/1GB...3150

### Vectra Xu

Pentium 90  
16mb, 1GB fast scsi, 4mb  
Matrox Video card  
**\$:3699**

### HP PENTIUM

SERVERS  
NETSERVER LC  
NETSERVER LF  
NETSERVER LH  
NETSERVER LM

### HP Omnibook

4000CT  
Dx4/100, 8/810mb, active  
\$3399  
with 810mb \$  
**CALL**  
for  
**OMNIBOOK**  
5000 Pentium

## Microsoft Solution Provider

## Windows 95

System setup / installation / upgrade,  
call us

## COMPAQ

Contura 4/33C.....4/170MB.....969  
Contura 410CX.....340MB.....2265

### New Models

Contura 420C...8/430MB...2385  
Contura 420CX..8/430MB..2950

Dx4/75, 8mb ram, 10.4" display

Contura 430C...8/730MB...2770

Contura 430CX..8/730MB..3379

Dx4/100, 8mb ram, 10.4" display

### LTE ELITE MODELS

LTE Elite 4/40CX 340MB..2899

LTE Elite 4/75CXL810MB..4399

\*\*\*Free LTE docking  
station \$ 700.00

### PROLINEA PENTIUM

P/75 8/720MB...2599  
P/90 16/720MB.2899  
P/100 16/720MB.3150  
P/120 16/1GB.....deal

### DESKPRO XL PENTIUM

P/75 16/1GB.. 3485  
P/90 16/1GB...3550  
P/100 16/1GB..3699  
P/120 16/1GB..deal

### COMPAQ SERVERS

PROSIGNIA 300 Pentium  
PROSIGNIA 500 Pentium  
PROLINAT 1000 Pentium  
PROLIANT 1500 Pentium  
PROLIANT 4000 Pentium  
PROLIANT 4500 Pentium

CALL

## AST notebook Special

Ascential 900n, Pentium 75 MHz, 8 MB ram, Active color  
with 1.2 GB hard Disk **\$ 5099**

Authorized Service Center  
for IBM, COMPAQ, TOSHIBA, HP  
All parts in stock

## PRINTER SPECIAL

OKIDATA OL400E.....399  
OKIDATA OL410E.....525  
EPSON ACTION 1100.....389  
OKIDATA ML 590.....425  
OKIDATA ML 591.....563

We carry full product  
range from above  
manufactures. call for

### Notebook

#### Accessories MEMORY

4MB.....199  
8MB.....399  
16MB.....deal  
HARD DRIVES  
2.5" 250MB.....199  
2.5" 340MB.....299  
2.5" 540MB.....345  
2.5" 840MB.....599  
PCMCIA MODEM  
ZOOM 14.4 .....159  
N/MEDIA 14.4...129  
M/HERTZ 14.4...175  
M/HERTZ 28.8...299

### Desktop

#### Accessories MEMORY

4MB.....150  
8MB.....279  
16MB.....deal  
HARD DISK  
420MB.....159  
540MB.....169  
850MB.....219  
1GB.....299  
2GB SCSI.....899  
MODEM  
14.4.....69  
28.8.....145

### CPU INTEL

P/75.....DEAL  
P/90.....329  
P/100.....410  
P/120.....750  
P/133.....CALL  
MOTHER  
BOARDS  
DX2/66.....99  
INTEL ZEPH  
TRITON.....285  
FLOPPY  
1.44MB.....31  
1.2MB.....41  
IDE I/O  
VLB.....25  
ISA 16 bit.....20

### MULTIMEDIA

CD ROM KITS  
Discovery 4X KIT.....325  
HITACHI 4X KIT.....285  
VALUE 4X KIT.....269  
CD ROM DRIVES  
TOSHIBA 4X IDE.....189  
TEAC 4X IDE.....189  
TOSHIBA 4X SCSI.....299  
NEC 6X SCSI.....459  
PLEXTOR 6X SCSI.....call  
PLEXTOR 4X SCSI.....call  
COMPUTER CASE  
MID TOWER.....65  
MINI TOWER.....59  
FULL TOWER.....89  
CALL FOR VIDEO CARDS

### Optical CD Drives

#### Recordable CD

Pinnacle RCD 1000.1699

Recordable Drive+scsi card+software

Sony syppressa 920.1599

Recordable drive

#### Rewritable CD

Sony 1.3GB optical drive.2299

Fujitsu 230MB optical .....deal

We also carry IBM, HP,  
PANASONIC ,call for price

# Computerlane Inc.

Corporate Accounts  
Volume  
Discounts  
Welcome

Outside California: 1-800- 526- 3482

Inside California: 818-884-8644 • Fax: 818-884-8253

7500 Topanga Cyn Blvd, Canoga Park, Ca 91303

Hours: Monday - Friday: 9 - 6

Circle 119 on Inquiry Card.

Compaq is a Registered Trademark Of  
Compaq. IBM is a Registered Trademark Of  
International Business Machines.  
All Quoted Prices Reflect A 5% Cash  
Discount. Visa, MasterCard, Wire Transfer  
Also Accepted.  
Prices Subject To Change Without Notice.



# Up to **4** Users can Access Multiple PC, Macintosh and Sun Computers from a Central Location!

- **Multiuser**

Up to 4 users have simultaneous access to any attached computer!

- **Multiplatform**

Supports any combination of PC, Macintosh and Sun computers; use any platform's peripherals to access any type of computer in the system.

- **Multimedia**

Every user has full multimedia capabilities; supports keyboard, mouse, video, speakers, microphone and serial port.

COME SEE US AT

Networks Expo, Dallas, TX

Sept. 12-14 1995 Booth #1696 &

Networld + Interop, Atlanta, GA

Sept. 27-29 1995 Booth #5166



AUTOBOOT  
**COMMANDER 4XP™**

Cybex Corporation

4912 Research Drive • Huntsville, AL 35805 USA

(205) 430-4000 • FAX (205) 430-4030



PC is a registered trademark of International Business Machines Corp. Macintosh is a registered trademark of Apple Computer, Inc. Sun is a trademark of Sun Microsystems. Cybex, Commander, AutoBoot and 4xP are trademarks of Cybex Corporation.

Dealer Program Available

Made in USA



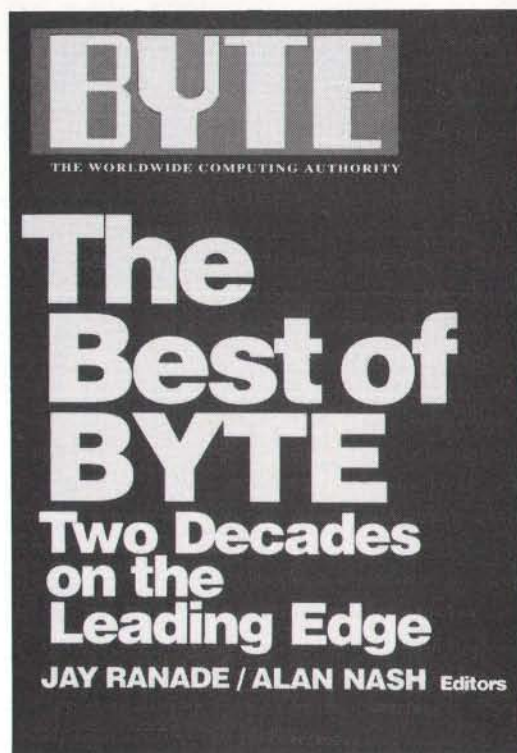
# THE ARTICLES THAT CHANGED THE WORLD MORE THAN A BIT—FROM BYTE

Only one magazine has been taking readers to the front lines of the microcomputing revolution since its inception almost two decades ago—*BYTE*!

Now you can relive the most glorious moments with this unrivaled chronicle of the evolution of this empowering technology. Here—and only here—you'll find the groundbreaking articles and features that *BYTE* alone had the vision to publish, including:

- Kernighan and Ritchie on C
- Stroustrup on C++
- Seminal pieces by Wozniak
- Articles covering the most important operating systems developments
- *BYTE* Awards from 1989-1992
- First-announcement product advertisements

You won't want to miss this invaluable new "best of" collection. Of course, all the bits of microcomputing's most significant magazine count—but, from time to time, some bits of *BYTE* change the world. Get them all with *The Best of BYTE*.



**\$24.95 (Paperback)**

**Available at your local bookstore  
or call toll-free 1-800-822-8158**



McGRAW-HILL, INC.



# JAMECO

ELECTRONIC COMPONENTS  
COMPUTER PRODUCTS

**BYTE**  
20 Years  
1973-1993

Special prices for BYTE readers only! Mention VIP #985

## Jameco 486DX 40MHz Bare-bones System

Includes motherboard, computer case and power supply. Monitor and keyboard not included.

- Cyrix CX486DX-40 CPU (P24T and all 486 CPUs upgradable)
- CPU ZIF socket
- Memory expandable to 64MB using (72-pin, 80ns) SIMMs
- 256KB cache memory
- Seven 16-bit with three 32-bit (VESA local bus) slot extensions

121507 CX486DX40MHz .....\$349.95

## Jameco Motherboards

- Some motherboards also available without CPU. Call for details
- Diagnostic and operating system software available
- One-year warranty

115941 80386SX 40MHz w/ CPU .....\$89.95  
117401 80386DX 40MHz w/ CPU .....\$129.95  
79214 80486SX 25MHz w/ CPU .....\$179.95  
116118 80486SLC 66MHz w/ CPU .....\$219.95  
95222 80486DX 33MHz w/ CPU .....\$249.95  
95169 \*80486DX w/o CPU .....\$139.95  
119731 486DX2 66MHz Motherboard .....\$329.95  
\*Applicable w/ DX2-66/50 or DX33/40/50

## IDE Hard Drives

- For laptops and standard cases

119087 7120A1 120MB 3.5" .....\$129.95  
119095 ST9145AG120MB 2.5" for laptops \$149.95  
123191 H2172-A2 172MB 2.5" for laptops \$159.95  
115764 CFS420A 426MB .....\$189.95  
93307 CFA540A 545MB .....\$199.95  
118949 CFA850A 850MB .....\$279.95  
124978 CFS1275A 1.27GB .....\$399.95  
67061 JE1066A 16-bit hard/floppy card .....\$29.95

## Floppy Disk Drives

- PC/XT/AT compatible
- P/N 120045 includes mounting kit & faceplate for use in 5.25" floppy disk drive bays

79396 Epson 360KB 5.25 .....\$39.95  
120045 Sony 1.44 MB 3.5" .....\$44.95  
118957 Panasonic 1.2 MB 5.25" .....\$39.95  
118922 Panasonic 1.44 MB 3.5" .....\$49.95  
119722 Toshiba 1.44 MB 3.5" .....\$49.95  
74392 Teac 3.5/5.25" Combo .....\$129.95

## Computer Power Supplies

- Fits most popular desktop, mini vertical and vertical cases
- 8088/80286/80386 and compatible
- One-year warranty
- Built-in fan

19465 150 Watt (8088) .....\$59.95  
67467 200 Watt (8088/80286) .....\$69.95  
19545 200 Watt .....\$79.95  
19529 200 Watt mini .....\$59.95  
65728 300 Watt .....\$119.95

## Portable IC Tester

- Hand-held & easy-to-operate
- Supports TTL, CMOS, DRAM 41, and DRAM 44 series
- Size: 7"L x 3.625"
- One-year warranty

73525 Portable IC tester .....\$139.95

# Your One Stop Component & Computer Source

## Jameco Multimedia Keyboard

NEW



- AT/PS2 and compatible systems
- 101-key layout
- Comes with PS/2 adapter
- Includes built-in, self-amplified speakers and microphone
- Inputs for headphones and external microphone
- Switchable line or speaker settings
- Power adapter included
- One-year warranty
- Size: 18.5"L x 9.0"W x 2.1"H
- Weight: 5.7 lbs.

High Performance Speakers

124089 Multimedia keyboard .....\$89.95

## EPROM Programmers

- Programs EPROM's, EEPROM's, and flash memories
- Programs 16KB to 8MB EPROM's
- Menu driven software
- Full screen buffer editor
- File formats supported: Intel Hex, Motorola S Hex, Tektronix Hex, and Binary
- 2 & 4-way Binary file splitting programs
- 2 & 4-way Binary file shifter programs
- Includes adapter card, software and manual
- Size: 7"L x 5.5"W x 1.75"H • One-year warranty

101400 1 Socket 16K-512KB .....\$129.95  
78457 1 Socket 16K-8MB .....\$199.95  
78465 4 Socket 16K-8MB .....\$249.95  
104651 1 Socket 16K-8MB Universal .....\$699.95

## EPROM Eraser

- Erases all erasable EPROMs
- Holds total of 16 pcs of 32-pin EPROM
- Has an upper and lower chamber for erasing
- Includes a variable timer settable between 10 to 60 minutes
- Timer turns the eraser off at the end of the selected time period.
- AC adapter included (9VDC @ 600mA)
- Special conductive foam liner eliminates static build-up • Size: 6.5"L x 2.75"W x 2.75"H
- Weight: 1.39 lbs. • One-year warranty

121267 EPROM Eraser .....\$119.95

## 14.4 Voice/Data/Fax Internal Modem

- PC/XT/AT & compatibles
- 14.4Kbps Fax/Voice/Data Communications
- MNP5 and CCITT v.42 bis data compression
- MNP2-4 and CCITT v.42 data error correction
- Supports international CCITT and Bell standards
- Group III send/receive fax group standard
- On-board 16550 compatible UART
- Includes Super Voice software for voice-mail fax and data communications features
- Weight: 1.2 lbs. • Requires Windows

123094 Internal Modem .....\$79.95

**JAMECO**  
ELECTRONIC COMPONENTS  
COMPUTER PRODUCTS

© 1995 Jameco 9/95

No Minimum Order  
Call for Details



Mention V.I.P.#985

## ACECAD ADVANCEDDigitizer

- Dual transducer ports for "on-the-fly" use of puck and optional pen
- MM1201 and Microgrid UIOF emulation
- Spacious 12" x 12" active area
- 2540 LPI resolution
- ACAD templates and dust cover included
- Easy Auto-Driver installation utility
- Includes WINTAB, ADI and MS Mouse Drivers
- Size: 15.6"W x 16"D x 1"H • Weight: 8.5 lbs.
- P/N 120117: 3-year warranty
- P/N 120125: One-year warranty

120117 12" x 12" Digitizer tablet .....\$199.95

120125 2-button pen for A-1212 .....\$39.95

## 3 Button Serial Mouse

- PC/XT/386/486 and compatible computers
- Microsoft® Mouse compatible
- One-year warranty
- Weight: 1 lb.

104441 3 Button serial mouse .....\$7.95

## External 250MB Tape Back-ups

- DOS environment supports QIC-40, QIC-80 and PC-36
- P/N 117786 can be used with Norton Back-up or PC Tools Back-up
- P/N 117751 includes easy to use software
- Interfaces with floppy system

117786 Tape backup without software .....\$99.95

117751 Tape backup with software .....\$119.95

## 9600 bps Fax Machine

VALUE

- Turns your computer printer into an intelligent, plain paper fax machine
- Prints high-quality faxes and transmits/receives high quality, computer-generated documents and graphics
- Maintains a floppy disk copy of all received faxes
- Includes fax forwarding, junk fax screening and scheduled transmission
- Weight: 5.5 lbs.

123131 9600bps fax machine .....\$49.95

## PACKARD BELL 14" Low Radiation SVGA Color Monitor

- PC/XT/AT, 386, 486, Pentium and compatible computers
- 0.28mm dot pitch
- Maximum resolution: 1024 x 768 (interlaced and non-interlaced)
- Input: DB15-pin (Analog)
- Scan frequency: Horizontal: 31.5KHz Vertical: 50-90Hz
- Manual and cable • Tilt/swivel base
- Low electro-magnetic radiation emissions
- Power: 120-240VAC, 50-60Hz, 85W max.
- Size: 14.5"W x 15.2"D x 12.9"H

119124 14" Super VGA monitor .....\$249.95

## Tired of IRQ conflicts?

### Jameco Fast Input/Output Card

- UART chips emulate 16550 UARTs
- 16-bit card
- PC/XT/AT and compatible computers
- Can be used in an 8-bit system with IRQ 3, 4, 5, 7
- Four serial ports - addressable to 3F8, 2F8, 3E8, 2E8
- Three parallel ports - addressable to 3BC, 378, 278
- All ports configurable to IRQ 3, 4, 5, 7, 9, 10, 11, 12, and 15
- Parallel ports are selectable for normal or bi-directional modes
- All ports are jumper selectable
- Cables and panel brackets included for all ports
- Three DB25 female parallel connectors
- One DB25 male and three DB9 male serial connectors
- Weight: 1 lb. • One-year warranty

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

117971 Input/Output card .....\$89.95

Add four serial and three parallel ports!

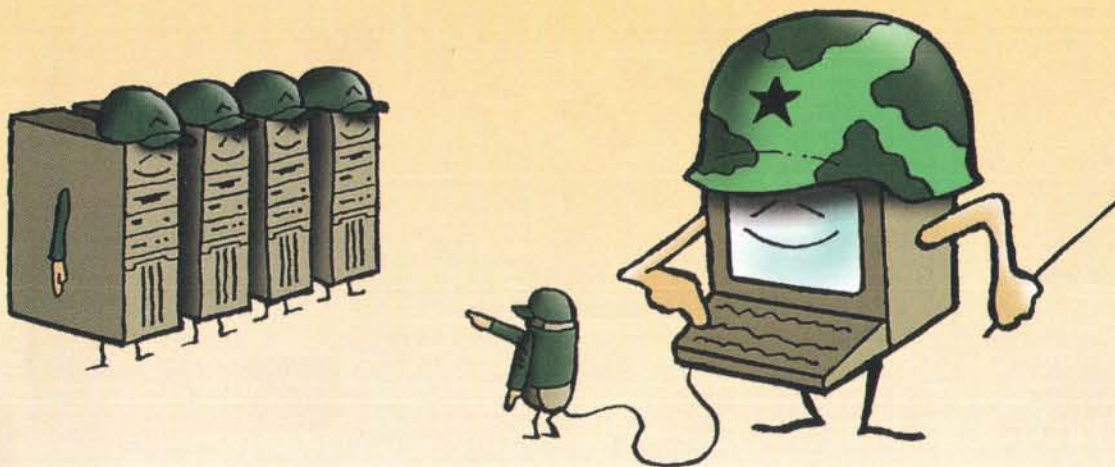
117971 Input/Output card .....\$89.95

Call 1-800-831-4242 to order today!



# Control up to 96 file servers with just 1 keyboard, monitor and mouse!

- Works with all 100% IBM compatible computers; built-in support for both PS/2 and serial mice
- Integral Sun and optional Macintosh support available
- KeyScan™ feature for keyboard-controlled scanning
- Add a second control center up to 150 feet away
- AutoBoot™ feature boots computers without operator intervention



**AUTOBOOT™  
COMMANDER**

COME SEE US AT

Networks Expo, Dallas, TX; Sept. 12-14 1995 Booth #1696 &  
Networld + Interop, Atlanta, GA; Sept. 27-29 1995 Booth #5166

An  
**Inc.  
500**  
Company

**Cybex Corporation**  
4912 Research Drive Huntsville, AL 35805 USA  
(205) 430-4000 (205) 430-4030 fax  
<http://www.cybex.com/>



Cybex, AutoBoot, Commander and KeyScan are trademarks of Cybex Corporation. IBM, PC and PS/2 are registered trademarks of International Business Machines Corporation. Macintosh is a registered trademark of Apple Computer, Inc. Sun is a trademark of Sun Microsystems.

**Dealer Program Available**

**Made in USA**

Circle 122 on Inquiry Card (RESELLERS: 123).



# ATI Free Shipping in USA for all Systems

## CUSTOM SYSTEMS FROM ATI



**72 HOURS BURN IN  
USA BUILT**

**MB  
&  
CPU**

### Practice System

- Motherboard & CPU
- 4MB of RAM 70nsec
- 8MB for Pentium Systems
- 420MB Hard Drive
- 3.5" Floppy Drive 1.44mb
- 1MB SVGA CARD 1024 x 768
- 14" SVGA monitor 0.28DP
- Minitor Case 230WTT PS
- 101 Enhanced Keyboard
- Mouse 3Button
- Free Preinstalled Software
- DOS 6.22 & Windows 3.11

### Family System

- Practice System With...
- Double Speed CD ROM
- Stereo Card 16Bit/MIDI
- 24/96 Fax/Modem MNP5
- Stereo Speakers
- Preinstalled Software Bundle
- CompuServe/America on Line
- Fax/Modem for Windows
- Sound Mixer Bundle for Windows
- DOS 6.22 & Windows 3.11

### Deluxe System

- Practice System With...
- 8MB RAM
- 540MB Hard Drive
- Dual Speed CD ROM
- Stereo Card 16Bit/MIDI
- Stereo Speakers
- Preinstalled Software Bundle
- CompuServe/America on Line
- Sound Mixer Bundle for Windows
- DOS 6.22 & Windows 3.11

**TRY BEFORE YOU BUY!** Over 200 fully working demos of commercial applications may be preinstalled with every system, and if you like it then buy it includes programs from Microsoft, Borland, Lotus, etc. Also includes over \$250 worth of fully working programs. **For Only \$ 9.99 upgrade code TDR**

PENTIUM 120 PCI, 256k	899	1699	1779	1799
PENTIUM 100 PCI, 256k	599	1399	1479	1499
PENTIUM 90 PCI, 256k	499	1299	1379	1399
PENTIUM 75 PCI, 256k	399	1199	1279	1299
486DX 4/100 VLB, 256k	229	929	1029	1279
486DX 2/80 VLB, 256k	199	899	999	1149
486DX 2/66 VLB, 256k	179	879	979	1129
486DX 2/50 VLB, 256k	169	869	969	1119

### CUSTOM UPGRADES

Code	Description	
4MB70	4Mb RAM	add \$ 139
540 MB IDE Hard Drive	.....	Call for best Price
1.0 GB IDE Hard Drive	.....	Call for best Price
12 GB IDE Hard Drive	.....	Call for best Price
12FD	12 Floppy Drive	add \$ 43
14.4FMI	14.4 Fax/Modem	add \$ 55
FMV	14.4 Fax/Modem/Voice	\$ 69
28.8FMI	28.8 Fax/Modem	\$ 119
NE2000C	NE2000 Card	\$ 34

Code	Description	
MTW	Medium Tower Case 230WTT PS	\$ 25
FTW	Full Tower Case 250WTT PS	\$ 45
GMI	Game Pad 6 button, 3D	\$ 29
JST	Joystick 3Button, Great for Games	\$ 9.99
MSR	Cordless Mouse, no wires, 400DPI	\$ 29.99
D64PI	Diamond Stealth 64PCI 1MB	\$ 119
D64VI	Diamond Stealth 64VLB 1MB	\$ 119
V2M	Add 1MB of Video RAM	\$ 49

**CALL FOR ANY OTHER UPGRADES**

Code	Description	
4XCD	4 X Speed CD ROM	add \$ 99
C420MQT	420MB TapeBackUp	add \$ 159
3BTRB	3B TrackBall	add \$ 19
SRGP	SurgeProtector	add \$ 4.99
14"NI	14" NI SVGA Monitor	add \$ 39
15"NI	15" NI SVGA Monitor	add \$ 99
17"NI	17" NI SVGA Monitor	add \$ 299
FAN486	486DX CPU Fan	add \$ 9.99
FAN586	Pentium Cooling Fan	add \$ 18
CDTL	14 CD titles	add \$ 49

incl. Comptons Encycy, RoboCop 3D, Etc

### WHY BUY FROM ATI ?

Our systems are built to the highest standard  
Using only best parts,  
Guaranteed IBM compatible  
Hassle free preinstalled & configured software  
**5 Year Warranty on systems call for details**

### MONTHLY SPECIAL 486 DX 100 Mhz BLUELIGHTNING

Only:  
**\$1299**  
PN MMI100



**BEST  
SELLER**

### FREE !!! SOFTWARE

- Comptons Encyclopedia
- The Chess Master
- US Atlas
- World Atlas
- Mavis Beacon Typing
- Life & Death II
- Contraption Zack
- RoboCop 3D
- P29 Retaliator
- PushOver
- Might & Magic II
- Epic Ocean
- Sound Mixer
- CD Player
- Modem for Windows
- Internet Software
- America On Line

- 486 DX 100 VESA/PCI LB 256k CACHE
- 4MB RAM up 64MB
- 420MB Hard Drive
- 3.5 Floppy Drive
- 1MB SVGA VIDEO
- Double Speed CD-ROM
- 16Bit Sound/Midi Card
- 14" SVGA Monitor NI 0.28
- 20Wt Speakers Built In
- Free 14.4 FAX/MODEM
- 101 Enhanced Keyboard
- 3Button Mouse
- DOS 6.2 & Windows 3.11

**3 year warranty on mainboard**

MMC80	486DX2/80Mhz	1229
MMC66	486DX2/66Mhz	1199

### MONTHLY SPECIAL SALE

#### MULTIMEDIA FAX MODEM VOICE



Up to 57.2 kbps Data  
14.4 Fax/Modem  
Voice/Data/Fax Autoswitch  
Voice Mail  
Simple Installation

Pager Notification,  
Remote Message retrieval  
Including software

**Only: \$ 69**  
PN# FMV

#### SIMM MEMORY

1MB x 3-70nsec	\$ 35 <sup>99</sup>
4MB x 9-70nsec	\$ 139 <sup>99</sup>
4MB 1x32-70nsec	\$ 145 <sup>99</sup>
8MB 2x32-70nsec	\$ 289 <sup>99</sup>
16MB 4x32-70nsec	\$ 499 <sup>99</sup>

#### BEST 486 DX MOTHERBOARDS

Takes 486 SX/DX/DX2/DX4/Pentium P24  
Deep Green Design, Pentium ready ZIP Socket  
Up to 1 MB Cache, 256k Installed  
Up to 64MB RAM  
2 x 72pin & 4 x 30pin SIMM  
3VESA & 7ISA SLOTS,  
AWARD BIOS  
Standard baby AT  
Uses Parity & Nonparity SIMM

with  
CPU



PN	CPU	Price \$
4MB100	486DX4/100	229
4MB80	486DX 2/80	199
4MB66	486DX 2/66	179
4MB501	486DX 2/50	169

**BEST  
BUY**

#### HARD DRIVE SALE

**1.2GB IDE . . . \$ 289**

Call for Current sale Item

**1GB IDE . . . \$ 279**

Call for Current sale Item

**540MB IDE . . . \$ 169**

Call for Current sale Item

**420MB IDE . . . \$ 158**

Call for Current sale Item

**CALL FOR  
ANY DRIVE**



#### VIDEO SUPERSALE

Diamond Stealth, 2MB PCI	\$ 199
1024 x 768, add \$ 155 for 4MB	
Diamond Stealth, 1MB VLB	\$ 109
1024x768, add \$55 for 2MB	
Trident 9440, 1MB VLB/PCI	\$ 89
1024 x 768, add \$ 55 for 2MB	
Trident 9400, 1MB VLB	\$ 75
1024 x 768, add \$ 55 for 2MB	
Trident 8900, 1MB ISA	\$ 69
1024 x 768	
Oak 8770, 1MB ISA	\$ 59
1024 x 768, Win Accel	

**ALL PARTS  
TESTED PRIOR TO SHIPPING !**

GlidePoint by  
ALPS  
• 400 DPI  
• Serial  
• No setup req.  
• Replaces  
Mouse



**Only: \$ 79**

Our policy is to satisfy every customer. That's why we offer a 30 days risk free guarantee and stand behind every sale. If you are not happy with your purchase we will gladly exchange the product or issue a credit less handling and shipping cost. There is NO CASH REFUND after 15 days store credit only or exchange.  
All returns must be in original condition and packaging or we can not accept them for return.  
We reserve the rights to refuse for return or charge up to 20% restocking fee.  
All returns or repairs must be shipped back to ATI freight prepaid and insured, bearing RMA number on the package.  
• ALL PRICES ARE FINAL. SHIPPING & HANDLING ARE EXTRA and  
NONREFUNDABLE. ALL PRICES REFLECT 3% CASH DISCOUNT. ALL SALES ARE  
MADE FOB SUNNYVALE, CA. PRICES ARE SUBJECT TO CHANGE. NOT RESPONSIBLE FOR TYPOS. 15% RESTOCKING FEE ON ALL RETURNS FOR REFUND

### A.T. INC

550 LAKESIDE DR. SUNNYVALE. CA 94086



**To Order Call  
1-800-858-2173**

FAX ORDERS: 408-774-9011  
RMA & TECH-SUPPORT 408-774-9010  
Free ground shipping for all systems over \$ 1000



# RECORD DISCOUNT HARDWARE WAREHOUSE

HOURS: MON-FRI 9:00-9:00 SAT 9:00-4:00 EST FAX 1-215-922-0116

## BEST HARD DRIVES 1995

### Seagate

Model	Capacity	Price
ST31200	1.2GB	\$119.95
ST31800	1.8GB	\$179.95
ST32100	2.1GB	\$219.95
ST32400	2.4GB	\$259.95
ST32700	2.7GB	\$299.95
ST33000	3.0GB	\$339.95
ST33600	3.6GB	\$399.95
ST34000	4.0GB	\$439.95
ST34800	4.8GB	\$519.95
ST35400	5.4GB	\$579.95
ST36000	6.0GB	\$639.95
ST36600	6.6GB	\$699.95
ST37200	7.2GB	\$759.95
ST37800	7.8GB	\$819.95
ST38400	8.4GB	\$879.95
ST39000	9.0GB	\$939.95
ST39600	9.6GB	\$999.95
ST310200	10.2GB	\$1059.95
ST310800	10.8GB	\$1119.95
ST311400	11.4GB	\$1179.95
ST312000	12.0GB	\$1239.95
ST312600	12.6GB	\$1299.95
ST313200	13.2GB	\$1359.95
ST313800	13.8GB	\$1419.95
ST314400	14.4GB	\$1479.95
ST315000	15.0GB	\$1539.95
ST315600	15.6GB	\$1599.95
ST316200	16.2GB	\$1659.95
ST316800	16.8GB	\$1719.95
ST317400	17.4GB	\$1779.95
ST318000	18.0GB	\$1839.95
ST318600	18.6GB	\$1899.95
ST319200	19.2GB	\$1959.95
ST319800	19.8GB	\$2019.95
ST320400	20.4GB	\$2079.95
ST321000	21.0GB	\$2139.95
ST321600	21.6GB	\$2199.95
ST322200	22.2GB	\$2259.95
ST322800	22.8GB	\$2319.95
ST323400	23.4GB	\$2379.95
ST324000	24.0GB	\$2439.95
ST324600	24.6GB	\$2499.95
ST325200	25.2GB	\$2559.95
ST325800	25.8GB	\$2619.95
ST326400	26.4GB	\$2679.95
ST327000	27.0GB	\$2739.95
ST327600	27.6GB	\$2799.95
ST328200	28.2GB	\$2859.95
ST328800	28.8GB	\$2919.95
ST329400	29.4GB	\$2979.95
ST330000	30.0GB	\$3039.95
ST330600	30.6GB	\$3099.95
ST331200	31.2GB	\$3159.95
ST331800	31.8GB	\$3219.95
ST332400	32.4GB	\$3279.95
ST333000	33.0GB	\$3339.95
ST333600	33.6GB	\$3399.95
ST334200	34.2GB	\$3459.95
ST334800	34.8GB	\$3519.95
ST335400	35.4GB	\$3579.95
ST336000	36.0GB	\$3639.95
ST336600	36.6GB	\$3699.95
ST337200	37.2GB	\$3759.95
ST337800	37.8GB	\$3819.95
ST338400	38.4GB	\$3879.95
ST339000	39.0GB	\$3939.95
ST339600	39.6GB	\$3999.95
ST340200	40.2GB	\$4059.95
ST340800	40.8GB	\$4119.95
ST341400	41.4GB	\$4179.95
ST342000	42.0GB	\$4239.95
ST342600	42.6GB	\$4299.95
ST343200	43.2GB	\$4359.95
ST343800	43.8GB	\$4419.95
ST344400	44.4GB	\$4479.95
ST345000	45.0GB	\$4539.95
ST345600	45.6GB	\$4599.95
ST346200	46.2GB	\$4659.95
ST346800	46.8GB	\$4719.95
ST347400	47.4GB	\$4779.95
ST348000	48.0GB	\$4839.95
ST348600	48.6GB	\$4899.95
ST349200	49.2GB	\$4959.95
ST349800	49.8GB	\$5019.95
ST350400	50.4GB	\$5079.95
ST351000	51.0GB	\$5139.95
ST351600	51.6GB	\$5199.95
ST352200	52.2GB	\$5259.95
ST352800	52.8GB	\$5319.95
ST353400	53.4GB	\$5379.95
ST354000	54.0GB	\$5439.95
ST354600	54.6GB	\$5499.95
ST355200	55.2GB	\$5559.95
ST355800	55.8GB	\$5619.95
ST356400	56.4GB	\$5679.95
ST357000	57.0GB	\$5739.95
ST357600	57.6GB	\$5799.95
ST358200	58.2GB	\$5859.95
ST358800	58.8GB	\$5919.95
ST359400	59.4GB	\$5979.95
ST360000	60.0GB	\$6039.95
ST360600	60.6GB	\$6099.95
ST361200	61.2GB	\$6159.95
ST361800	61.8GB	\$6219.95
ST362400	62.4GB	\$6279.95
ST363000	63.0GB	\$6339.95
ST363600	63.6GB	\$6399.95
ST364200	64.2GB	\$6459.95
ST364800	64.8GB	\$6519.95
ST365400	65.4GB	\$6579.95
ST366000	66.0GB	\$6639.95
ST366600	66.6GB	\$6699.95
ST367200	67.2GB	\$6759.95
ST367800	67.8GB	\$6819.95
ST368400	68.4GB	\$6879.95
ST369000	69.0GB	\$6939.95
ST369600	69.6GB	\$6999.95
ST370200	70.2GB	\$7059.95
ST370800	70.8GB	\$7119.95
ST371400	71.4GB	\$7179.95
ST372000	72.0GB	\$7239.95
ST372600	72.6GB	\$7299.95
ST373200	73.2GB	\$7359.95
ST373800	73.8GB	\$7419.95
ST374400	74.4GB	\$7479.95
ST375000	75.0GB	\$7539.95
ST375600	75.6GB	\$7599.95
ST376200	76.2GB	\$7659.95
ST376800	76.8GB	\$7719.95
ST377400	77.4GB	\$7779.95
ST378000	78.0GB	\$7839.95
ST378600	78.6GB	\$7899.95
ST379200	79.2GB	\$7959.95
ST379800	79.8GB	\$8019.95
ST380400	80.4GB	\$8079.95
ST381000	81.0GB	\$8139.95
ST381600	81.6GB	\$8199.95
ST382200	82.2GB	\$8259.95
ST382800	82.8GB	\$8319.95
ST383400	83.4GB	\$8379.95
ST384000	84.0GB	\$8439.95
ST384600	84.6GB	\$8499.95
ST385200	85.2GB	\$8559.95
ST385800	85.8GB	\$8619.95
ST386400	86.4GB	\$8679.95
ST387000	87.0GB	\$8739.95
ST387600	87.6GB	\$8799.95
ST388200	88.2GB	\$8859.95
ST388800	88.8GB	\$8919.95
ST389400	89.4GB	\$8979.95
ST390000	90.0GB	\$9039.95
ST390600	90.6GB	\$9099.95
ST391200	91.2GB	\$9159.95
ST391800	91.8GB	\$9219.95
ST392400	92.4GB	\$9279.95
ST393000	93.0GB	\$9339.95
ST393600	93.6GB	\$9399.95
ST394200	94.2GB	\$9459.95
ST394800	94.8GB	\$9519.95
ST395400	95.4GB	\$9579.95
ST396000	96.0GB	\$9639.95
ST396600	96.6GB	\$9699.95
ST397200	97.2GB	\$9759.95
ST397800	97.8GB	\$9819.95
ST398400	98.4GB	\$9879.95
ST399000	99.0GB	\$9939.95
ST399600	99.6GB	\$9999.95
ST400200	100.2GB	\$10059.95
ST400800	100.8GB	\$10119.95
ST401400	101.4GB	\$10179.95
ST402000	102.0GB	\$10239.95
ST402600	102.6GB	\$10299.95
ST403200	103.2GB	\$10359.95
ST403800	103.8GB	\$10419.95
ST404400	104.4GB	\$10479.95
ST405000	105.0GB	\$10539.95
ST405600	105.6GB	\$10599.95
ST406200	106.2GB	\$10659.95
ST406800	106.8GB	\$10719.95
ST407400	107.4GB	\$10779.95
ST408000	108.0GB	\$10839.95
ST408600	108.6GB	\$10899.95
ST409200	109.2GB	\$10959.95
ST409800	109.8GB	\$11019.95
ST410400	110.4GB	\$11079.95
ST411000	111.0GB	\$11139.95
ST411600	111.6GB	\$11199.95
ST412200	112.2GB	\$11259.95
ST412800	112.8GB	\$11319.95
ST413400	113.4GB	\$11379.95
ST414000	114.0GB	\$11439.95
ST414600	114.6GB	\$11499.95
ST415200	115.2GB	\$11559.95
ST415800	115.8GB	\$11619.95
ST416400	116.4GB	\$11679.95
ST417000	117.0GB	\$11739.95
ST417600	117.6GB	\$11799.95
ST418200	118.2GB	\$11859.95
ST418800	118.8GB	\$11919.95
ST419400	119.4GB	\$11979.95
ST420000	120.0GB	\$12039.95
ST420600	120.6GB	\$12099.95
ST421200	121.2GB	\$12159.95
ST421800	121.8GB	\$12219.95
ST422400	122.4GB	\$12279.95
ST423000	123.0GB	\$12339.95
ST423600	123.6GB	\$12399.95
ST424200	124.2GB	\$12459.95
ST424800	124.8GB	\$12519.95
ST425400	125.4GB	\$12579.95
ST426000	126.0GB	\$12639.95
ST426600	126.6GB	\$12699.95
ST427200	127.2GB	\$12759.95
ST427800	127.8GB	\$12819.95
ST428400	128.4GB	\$12879.95
ST429000	129.0GB	\$12939.95
ST429600	129.6GB	\$12999.95
ST430200	130.2GB	\$13059.95
ST430800	130.8GB	\$13119.95
ST431400	131.4GB	\$13179.95
ST432000	132.0GB	\$13239.95
ST432600	132.6GB	\$13299.95
ST433200	133.2GB	\$13359.95
ST433800	133.8GB	\$13419.95
ST434400	134.4GB	\$13479.95
ST435000	135.0GB	\$13539.95
ST435600	135.6GB	\$13599.95
ST436200	136.2GB	\$13659.95
ST436800	136.8GB	\$13719.95
ST437400	137.4GB	\$13779.95
ST438000	138.0GB	\$13839.95
ST438600	138.6GB	\$13899.95
ST439200	139.2GB	\$13959.95
ST439800	139.8GB	\$14019.95
ST440400	140.4GB	\$14079.95
ST441000	141.0GB	\$14139.95
ST441600	141.6GB	\$14199.95
ST442200	142.2GB	\$14259.95
ST442800	142.8GB	\$14319.95
ST443400	143.4GB	\$14379.95
ST444000	144.0GB	\$14439.95
ST444600	144.6GB	\$14499.95
ST445200	145.2GB	\$14559.95
ST445800	145.8GB	\$14619.95
ST446400	146.4GB	\$14679.95
ST447000	147.0GB	\$14739.95
ST447600	147.6GB	\$14799.95
ST448200	148.2GB	\$14859.95
ST448800	148.8GB	\$14919.95
ST449400	149.4GB	\$14979.95
ST450000	150.0GB	\$15039.95
ST450600	150.6GB	\$15099.95
ST451200	151.2GB	\$15159.95
ST451800	151.8GB	\$15219.95
ST452400	152.4GB	\$15279.95
ST453000	153.0GB	\$15339.95
ST453600	153.6GB	\$15399.95
ST454200	154.2GB	\$15459.95
ST454800	154.8GB	\$15519.95
ST455400	155.4GB	\$15579.95
ST456000	156.0GB	\$15639.95
ST456600	156.6GB	\$15699.95
ST457200	157.2GB	\$15759.95
ST457800	157.8GB	\$15819.95
ST458400	158.4GB	\$15879.95
ST459000	159.0GB	\$15939.95
ST459600	159.6GB	\$15999.95
ST460200	160.2GB	\$16059.95
ST460800	160.8GB	\$16119.95
ST461400	161.4GB	\$16179.95
ST462000	162.0GB	\$16239.95
ST462600	162.6GB	\$16299.95
ST463200	163.2GB	\$16359.95
ST463800	163.8GB</	



# RACK MOUNT PC SYSTEMS AND ENCLOSURES

## COMPUTER SYSTEMS & ENCLOSURES

- ◆ Computers available with 486 or Pentium processors.
- ◆ 8 or 14 slots for Motherboards or passive backplanes.
- ◆ Enclosures with built-in mono or color monitors.
- ◆ All drive bays are shock mounted.
- ◆ Accommodates full height & full length cards.
- ◆ Card retainer to firmly hold plug-in cards.
- ◆ 250W power supply w/ front panel on/off switch.
- ◆ Front panel keylock/reset switches & LED status displays.



## MONITORS

- ◆ Models from 9" MONO to 17" Ultra SVGA monitors.
- ◆ Active TFT LCD display monitor also available.
- ◆ Tinted Lexan shield on 9" to 10" monitors.
- ◆ 12" to 14" desktop monitor enclosures.
- ◆ Automatic degaussing at power on.
- ◆ Standard 15-pin input connector on all color models including TFT LCD model.



## CPU CARDS

- ◆ 486 to Pentium CPU cards.
- ◆ PCI/ISA Pentium boards with on-board SCSI-II, E-IDE, RS232/422/485 ports, & enhanced parallel port.
- ◆ 486 boards with on-board VL VGA & optional SCSI-II.
- ◆ ISA and PCI/ISA backplanes to 14 slots.

**For rack mount computers, enclosures, monitors, keyboards, and printers - from standard enclosures to custom configurations - our field proven products provide the most cost effective and reliable solution.**

## KEYBOARDS

- ◆ 101 K/B with or without mouse holder.
- ◆ Standard AT 101 keyboard enclosure available with storage space for K/B and mouse.
- ◆ Slides for rack included.



## PRINTERS

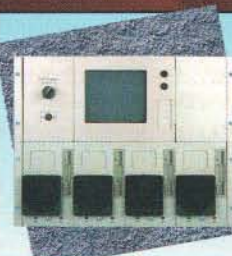
- ◆ Microline 184T dot matrix printer.
- ◆ IBM graphics compatible.
- ◆ All operator controls easily accessible.
- ◆ Large storage for roll or fanfold paper.
- ◆ Standard IBM parallel printer interface.
- ◆ Serial printer interface also available.



Now on the Internet at:  
[www.industry.net/recortec](http://www.industry.net/recortec)

## UniMod™ MODULAR COMPUTER SYSTEMS

- ◆ Independent 4, 8, and 14 slot computer modules.
- ◆ 486 or Pentium CPU's with various memory & hard drive sizes.
- ◆ 7" mono TTL or 7" mono VGA monitors.
- ◆ Multiple configurations can be combined in 7 inches of vertical rack space.
- ◆ Individual module power supply and filtered cooling fan.
- ◆ Available with either AC or DC power supplies.



Advertisement



## Rack Mount Enclosure with TFT LCD

The **RME-180** 8 slot computer enclosure features a built-in 9.4", 4096 colors, active matrix TFT LCD display. The display which requires no special cards or drivers, connects directly to standard VGA cards. The enclosure contains a 250W power supply and is supplied with equipment slides. A 14 slot version (**RME-184**) and complete computer systems are also available.  
**RECORTec, INC. 1-800-729-7654.**  
**Circle 350 on Inquiry card.**



## Rack Mount Keyboard with Mouse

The **RMK-111S** industrial rack mount keyboard combines a reduced width 101 key keyboard and a **400dpi serial touch pad mouse**. For maximum accessibility and use, the mouse is centered between the "G" and "H" keys. A palm rest is built into the keyboard for a comfortable typing position. The **RMK-111P** with a PS/2 touch pad mouse is also available. Both models are only 1.75 inches high and \$295.00 each at quantity one.  
**RECORTec, INC. 1-800-729-7654.**  
**Circle 351 on Inquiry card.**



## Rack Mount 17" Ultra VGA Monitor

The **RMM-237** is a rack mounted 0.26mm dot pitch 17" Ultra VGA color monitor. The rack mounted monitor also has a FST, dark glass, non-glare tube and INVAR mask. It contains a microprocessor based digital control system with a maximum non-interlaced resolution of 1280 x 1024. The rack mounted frame is constructed of rugged 14 GA steel while the back of the monitor is fully enclosed in an aluminum housing. Quantity 10 pricing is at \$1095.00 per unit.  
**RECORTec, INC. 1-800-729-7654.**  
**Circle 352 on Inquiry card.**

Call for free catalog

**1-800-729-7654**

**RECORTec, INC.**

1290 Lawrence Station Road, Sunnyvale CA 94089

Tel: (408) 734-1290

Fax: (408) 734-2140

**RACKFAX™**  
(408) 734-9374  
Fax-On-Demand System



Made In  
**USA**



Circle 126 on Inquiry card.





**FUTURE  
MICRO**  
World Leader  
in PC Upgrades



## Pentium Mother Board Upgrades

**Intel Advanced/ZP**  
3 PCI, 4 ISA, 256k Cache  
PCI Enhanced IDE, FDD, 2 Ser, 1 Par, Built In  
Intel Flash BIOS, Intel Triton Chipset  
90/100/120MHz ..... \$289  
Call for Info on the Latest Intel Motherboards

**Super P55CWA-PCI w/Intel VRM**  
**Universal Motherboard Architecture**  
4 PCI, 4 ISA Slots, 2 PCI IDE Controllers  
Intel Triton Chipset, AMI Flash BIOS  
75-133MHz, Supports EDO Memory  
256 to 512k Cache ..... \$299  
With Adaptec 2940 PCI SCSI add ..... \$200

**GA-586ID PCI/EISA DUAL PROCESSOR**  
3 PCI, 5 EISA, 1 or 2 Pentium CPU's  
Exp to 196MB, 512k Cache  
AwardFlash BIOS, IntelChipset 90/100MHz \$650

**GA-586AT PCI-ISA**  
3 PCI, 4 ISA, 2 IDE Channels, FDD  
2 16550 Ser, 1 ECP/EPP Par  
256k-512k Cache, Standard or EDO Ram  
Award Flash BIOS, Intel Triton Chipset  
75-150MHz ..... \$259

**Super P55CM-PCI w/Intel VRM**  
4 PCI, 4 ISA Slots, 2 PCI IDE Controllers  
2 16550 Ser, 1 EPP Par, FDD Support  
Intel Triton Chipset, AMI Flash BIOS  
75-133MHz, PS/2 Mouse Port  
Pipeline Burst Cache, 256 to 512k Cache ..... \$CALL  
With Adaptec 2940 PCI SCSI add ..... \$200

**P54 PCI**  
4 PCI, 4ISA 256k Cache Exp. to 512k  
AMI BIOS, SIS Chipset  
90/100MHz ..... \$139

## 486 MOTHERBOARDS

**GA-486VF/VS**  
Uses [8] 30 Pin SIMMs (VF) or [4] 72 Pin (VS)  
3 VL Slots, 7 total, 256k Cache, Exp. to 512k  
Award BIOS, SIS Chipset, 3.385 Volt  
Deep Green, Accepts all 486 Chips & P24T  
\$125 w/512k S205  
Now Available with 8-30 & 2-72 pin sockets!

**GA-486AM PCI**  
3 PCI, 4 ISA  
Built in PCI IDE, FDD & Hi-Speed I/O  
256k Cache, Exp. to 512k  
Award BIOS, UMC Chipset, Deep Green  
3.3/5 Volt Switchable  
Accepts all 486 Chips & P24T ..... \$167

## CPU CHIPS

### CALL FOR LATEST PRICING

**Intel**  
Pentium 120/133/150 ..... \$775/995/CALL  
Pentium 90/100 ..... \$339/395  
Pentium 60/66/75 ..... 199/279/349  
P24T(Pentium Overdrive) 63/83MHz ..... CALL  
486DX4-75/100 ..... \$189/229  
486DX2-66 ..... \$139  
486DX2-50 ..... \$125  
486DX-50 ..... \$189  
486DX-33 ..... \$87  
486SX-25/33 ..... \$37/55  
OverDrive ODP/ODPR ..... CALL  
**AMD/Cyrix**  
486DX4-100 ..... \$175  
486DX2-80 ..... \$153  
486DX2-66 ..... \$129  
486DX2-50 ..... \$119  
**Cyrix 386 to 486 Upgrades**  
486DX2-25/50 ..... \$199  
486DX2-33/66 ..... \$250  
486SX2-25/50 ..... \$199  
Call for Latest CPU Pricing/Info/Specials!

Our sales staff is ready to  
provide advice on the most  
cost-effective 486 or Pentium  
upgrades for your computer.

**Future Micro, Inc.** 2691 Richter Ave. #118, Irvine CA, 92714  
(714) 622-9130 FAX (714) 622-9143  
Customer Service/Tech Support (714) 622-9136

30 Day Money Back Guarantee

Terms and Conditions: 20% Restock fee on non-defective returns. No refunds after 30 days. Shipping charges are non-refundable. Not responsible for typographical errors. Prices subject to change without notice. Two year warranty on non-memory products, lifetime warranty on memory. RMA required for all returns.

## BAREBONES

**Super P55CWA Bare Bones**  
Mid Tower Case w/Digital Display, 7 Bays  
2 PCI IDE, 2 Ser, 1 Par, 1 Game  
Trident PCI SVGA 1MB, 256k Cache  
Pentium 90/100/120 ..... \$799/897/CALL  
w/1.44 Floppy add \$35  
THE ULTIMATE UPGRADE!!!

**GA-486VF/VS Bare Bones**  
Mini Tower Case w/Digital Display, 5 Bays  
VLB IDE-IO, 2 Ser, 1 Par, 1 Game  
Trident VLB SVGA 1MB, 256k Cache  
486DX2-66/100 ..... \$379/439  
w/1.44 Floppy add \$35 ..... PCI add \$50  
Call for Custom Bundles

## MEMORY

### CALL FOR LATEST PRICING

**72 Pin SIMMs**  
1 X 36 60/70/80ns (4mb) ..... \$175/159/149  
1 X 32 60/70/80ns (4mb) ..... \$157/149/142  
2 X 36 60/70/80ns (8mb) ..... \$345/325/319  
2 X 32 60/70/80ns (8mb) ..... \$325/299/299  
4 X 36 60/70ns (16mb) ..... \$545/529  
4 X 32 60/70ns (16mb) ..... \$495/479  
8 X 36 60/70ns (32mb) ..... \$1130/1050  
8 X 32 60/70ns (32mb) ..... \$1080/950  
**30 Pin SIMMs**  
1 X 3 60/70/80ns (1mb) ..... \$45/40/39  
1 X 9 60/70/80ns (1mb) ..... \$45/42/39  
4 X 3 60/70ns (4mb) ..... \$135/130  
4 X 9 60/70/80ns (4mb) ..... \$149/142/138  
16 X 9 60/70ns (16mb) ..... CALL  
**DRAM & VRAM**  
256k X 4 70/80ns, 1 X 1 70/80ns ..... \$6  
256k X 4 70/80ns 28 Pin VRAM ZIP ..... \$11  
256k X 16 70ns ZIP/SOI ..... CALL  
**Cache**  
32k X 8 15/20/25ns ..... \$8/7/6  
128k X 8 15/20/25ns Slim/Wide ..... \$36/34/30

We will buy CPU's and used  
or defective memory chips.  
Cash, Trade or Credit  
toward future purchase.

# WINDOWS 95 HARDWARE UPGRADE EXPERTS

## MONTHLY SPECIALS

**Super P55CWA/GA-586AT**  
w/90/100/120MHz ..... \$595/679/CALL  
**Quad Spin 4X CD/Sound Blaster 16**  
and Speakers ..... \$299  
**560MB/1GB-IDE HDD .... \$179/299**  
AHA 2940 SCSI only \$200 w/Pentium Boards

**GA486VF/VS**  
30 or 72 Pin Version w/Fan  
w/486DX4-100 ..... \$279  
w/486DX2-80 ..... \$255  
w/486DX2-66 ..... \$239  
With VLB IDE-IO & VLB SVGA 1MB add ..... \$100  
**486DX4-100 OVERDRIVE ODP/ODPR ..... \$225**

**CALL FOR INFO ON OUR DAILY SPECIALS AND BLOWOUTS**

## VIDEO

Trident PCI/VLB/ISA 1MB ..... \$79  
Cirrus Logic 5428 PCI/VLB 1/2MB ..... \$79/\$136  
S3 32 Bit PCI/VLB 1/2MB ..... \$77/\$140  
**Diamond**  
Stealth 64 PCI/VLB Video VRAM 2/4MB .. \$279/485  
Stealth 64 PCI/VLB DRAM 1/2MB ..... \$149/\$199  
Speedstar 64 PCI/ISA 1/2MB ..... \$155/\$205  
Viper Pro PCI/VLB 4MB ..... \$559  
**ATI**  
Mach 64 VRAM PCI/VLB 2/4MB ..... \$279/489  
Mach 64 DRAM PCI/VLB 1/2MB ..... \$169/239  
#9 IMAGINE 128bit 2/4/8MB ..... CALL

## MODEMS

14.4 Int Fax/Modem ..... \$59  
14.4 Int Voice Fax/Modem ..... \$85  
28.8 Int Fax/Modem ..... \$125  
28.8 Int Voice Fax/Modem ..... \$145

## MULTIMEDIA

### Sound Boards

**Creative Labs**  
Sound Blaster 16 MCD ..... \$89  
Sound Blaster 16 SCSI-2 ..... \$135  
Sound Blaster AWE 32 ..... \$295  
Sound Blaster AWE 32 VE ..... \$220

### CD-ROM Drives

**Toshiba**  
3601 SCSI 4X Int ..... \$309  
XM5301 4X SCSI ..... \$289  
XM5302 4X IDE ..... \$235  
**Mitsumi/Panasonic**  
2X Internal ..... \$109  
4X Internal IDE ..... \$189  
**Teac** CD-55A 4X ..... \$185  
**Sanyo** 4X SCSI ..... \$219  
External SCSI -CD/Hard Drive Cases w/Power  
Single/Double Bay ..... \$89/137

## HARD DISK CONTROLLERS

**IDE**  
ISA IDE/IO ..... \$15  
ISA IDE/IO Enh Par & 16550's ..... \$39  
VLB IDE/IO ..... \$25  
VLB IDE/IO Enh Par & 16550's ..... \$39  
VLB IDE Cache 0k/1MB ..... \$119/\$149  
PCI IDE ..... \$29  
PCI IDE/IO Combo ..... \$55  
PCI IDE Cache ..... \$185

**SCSI**  
**Adaptec**  
AHA-2940W PCI ..... \$339  
AHA-2940 PCI ..... \$249  
AHA-2842 VLB ..... \$255  
AHA-2742 EISA ..... \$295  
AIC-6360 VLB ..... \$125  
SLIM SCSI ..... \$279  
AMM-1570 SCSI w/Audio ..... \$299

## HARD DRIVES

**Maxtor**  
1260A 1260MB 11ms IDE ..... \$339  
7850A 850MB 11ms IDE ..... \$239  
7540AV 540MB 10ms IDE ..... \$199  
**Western Digital**  
2540 540MB 11ms IDE ..... \$199  
31000 1080MB 10ms IDE ..... \$339  
31200 1280MB 10MS IDE ..... \$355  
31600 1620MB 9ms IDE ..... \$559  
**Conner**  
540A 540MB 12ms IDE ..... \$199  
850A 850MB 10ms IDE ..... \$245  
1275A 1.3Gig 10ms IDE ..... \$360  
1080S 1GB 11ms SCSI ..... \$469  
2147S 2.1 GB 9ms SCSI ..... \$799  
4207S 4.2GB 9ms SCSI ..... \$1578  
**Seagate**  
3660A 540MB 12ms IDE ..... \$199  
31220A 1GB 12ms IDE ..... \$339  
31230N 1GB 9ms SCSI ..... \$489  
32550N 2.1GB 8ms SCSI ..... \$979  
**Quantum**  
540MB Lightning 11ms EIDE ..... \$199  
1GB Fireball 12ms EIDE ..... \$319  
1GB Fireball 11ms SCSI ..... \$459  
2.1GB SCSI 8ms ..... \$969  
4.2GB SCSI 8.5ms ..... \$1479  
**IOmega ZIP Drive ..... \$199**  
Call for Micropolis & Laptop Drives

## LASER PRINTER MEMORY

**HP II, III, IV & HP HP II, III, IV, HP**  
1MB \$69, 2MB \$95, 4MB \$169  
**HP4L 1MB \$50**  
**HP4 Series** 2MB \$85, 4MB \$165, 8MB \$335  
**HPDeskJet 500 Series** 256K \$59  
**Panasonic 4410, 4430, 4420, 4450i**  
2MB \$115, 4MB \$185  
**Epson AL II, 1000, 1100, 1500, 1600**  
**5000, 5200, 7000, 8000**  
2MB \$125, 4MB \$199  
**Canon, IBM, TI, NEC, OKI & More CALL**

We Carry: Cases, Floppies, KeyBoards, Mice  
Ethernet, Laptop Acc. and Much More! Upgrades  
for All Major Brands, Including Packard Bell

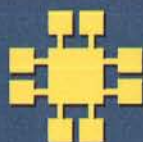
## THE FUTURE MICRO DIFFERENCE

- © Easy Installation Instructions
- © Free Technical Assistance
- © 30 Day Money Back Guarantee
- © Overnight Delivery Available
- © Accept PO's from Corporate, Gov't and Educational Institutions
- © Gov't, Educational Discounts
- © No Surcharge on Credit Cards



**800-700-6502**





Serving you since 1979

# JDR Microdevices®

1850 SOUTH 10TH STREET, SAN JOSE CA 95112-4108



**Special Prices for  
Byte Buyers!  
Good Through 10/31/95**

To receive these special  
prices, you must mention  
key code #1069

## LANtastic Network Starter Kit

Artisoft's LANtastic starter system is ideal for environments that require a small peer-to-peer Local Area Network.

- Selected by PC Magazine as Editor's Choice for low-cost LANs
- Includes two network adaptors, the network software, a 25' thin Ethernet cable and terminators

NR2000SKC ..... \$279.95



## 10BaseT Concentrator

Couple up to eight 10BaseT twisted pair lines using RJ45 connectors instead of thick and thin coaxial. 10BaseT operates in a star topology to protect you from complete system crashes.

- Cascade up to 7 units using BNC or 10BaseT port
- Uses standard RJ45 connectors to 10BaseT nodes

HUB-008 SPECIAL FOR BYTE CUSTOMERS ONLY! ..... \$129.95

HUB-016 ..... \$299.95

16-port vers.w/thick adaptor, mounts in standard 19" racks

**\$129.95**  
BYTE Special



## MCT Network Cards Cost Less!

These cards feature a jumperless design so that software can automatically configure the card for you! A 16Kb RAM buffer is included for faster network transmission and reception.

- 8/16-bit PC compatible ISA cards
- NE-2000 compatible

MCT-10B2 Thin Net BNC connector only ..... \$39.95

MCT-10B1 10BaseT RJ45 connector only ..... \$39.95



## Seagate Hard Drives

Upgrade to a new, high-quality, high-capacity Seagate hard drive—our prices have never been lower!

- As low as 31¢ a meg!
- Fast ATA and Fast SCSI-2 drives accelerate performance

ST-3660A 545Mb, 14ms, 120Kb, IDE-Fast ATA ..... 178.67

SPECIAL FOR BYTE CUSTOMERS ONLY!

ST-5850A 850Mb, 11ms, 256Kb, IDE-Fast ATA-2 ..... 259.95

ST-31220A 1.08Gb, 12ms, 256Kb, IDE-Fast ATA-2 ..... 349.95

ST-31230N 1.05Gb, 10ms, 512Kb, Fast SCSI-2 ..... 539.00

ST-32430N 2.1Gb, 10ms, 512Kb, Fast SCSI-2 ..... 939.00

ST-32550N 2.1Gb, 9ms, 512Kb, Fast SCSI-2 ..... 1099.00

ST-15150N 4.2Gb, 9ms, 1024Kb, Fast SCSI-2 ..... 1649.00



**\$178.67**  
BYTE Special

## Modular Network Cables

Stranded 24-gauge PVC cable for network patch cords. These category 5 cables are wired straight-through for standard data requirements.

Part #	Connectors	Length	Price
PHS-8CT5-7	RJ45	7'	6.95
PHS-8CT5-14	RJ45	14'	8.95
PHS-8CT5-25	RJ45	25'	11.95
PHS-8CT5-50	RJ45	50'	14.95
PHS-8CT5-100	RJ45	100'	19.95
CBL-8CT5-100	None	100' Spool	14.95
CBL-8CT5-1000	None	1000' Spool	129.95



## FREE JDR CATALOGS!

**PC PRODUCTS  
AND ELECTRONIC  
COMPONENTS**  
**CALL US  
TOLL-FREE!**

**1-800-538-5000**



## Display PC Video on Your TV!

Convert your VGA output so that you can connect to a big-screen TV or other NTSC monitor or videotape a presentation using your VCR.

- Supports Windows 3.0 & higher; compatible with all VGA cards
- Supports all IBM standard modes up to 640 x 480 Hi-Color (NTSC)

VGA-NTSC ..... \$149.95

Note: Outputs S-video and composite video for use with TV or video recorder



## Backup Hard Drives to 340Mb\*!

Using low-cost Quarter Inch Cartridge (QIC) technology, these drives provide a proven way to create reliable tape backups. Includes software.

- PC-compatible 5-1/4" internal half-height drive
- Reads QIC-40 and reads/writes QIC-80 formatted tapes, including extended length

DJ-35C ..... \$149.95

\*Note: Maximum tape capacity using data compression



**\$149.95**  
BYTE Special

## Upgrade Motherboards Featuring Intel's Pentium Processor

Upgrade your system to a faster Pentium Processor using MCT's upgrade motherboard. Features up to four PCI slots for 32-bit speed and up to four ISA slots for compatibility with your existing cards.

- 75MHz, 90MHz or 120MHz Intel Pentium Processor with 16Kb internal cache memory and SIS chip set
- RAM expandable on board to 128Mb, with 4 SIMM sockets, using 1M x 36, 2M x 36, 4M x 36 or 8M x 36 70ns 72-pin SIMMs in multiples of 2 (0Kb installed)

MCT-S586-75 75MHz version ..... \$569.00

MCT-S586-90 90MHz version ..... \$699.00

MCT-S586-120 120MHz version ..... \$1169.00

SPECIALS FOR BYTE CUSTOMERS ONLY!



**\$569**  
BYTE Special

## Leap to 486DX4 Performance!

For increased 486 performance from your 486SX or DX motherboard, simply plug in Intel's DX4 or DX2 OverDrive Processor!



BOXDX40DP100 Plugs into 33MHz socket ..... \$249.95

BOXDX40DP100 Replaces 33MHz CPU ..... \$249.95

BOXDX40DP75 Plugs into 25MHz socket ..... \$169.95

BOXDX40DP75 Replaces 25MHz CPU ..... \$169.95

BOXDX20DP-66 Plugs into 33MHz socket ..... \$139.95

BOXDX20DP-66 Replaces 33MHz CPU ..... \$139.95

BOXPD05V63 ..... \$389.95

Pentium OverDrive replaces 25MHz and 50MHz CPUs

## Keep Your CPU Cool!

Make your processor run cooler with these specially designed fans. They feature easy snap-in installation so you don't have to remove your CPU. The in-line adaptor draws power from your floppy drive.



P54C-FAN For Pentium processors ..... \$29.95

P54C-FAN-R Above with refrigeration device ..... \$79.95

486-FAN For 486 processors ..... \$19.95

486-FAN-R Above with refrigeration device ..... \$49.95

## Memory Modules

**DUE TO CURRENT MARKET CONDITIONS,  
CALL FOR CURRENT DRAM PRICES!**

Part #	Size	Speed	Type	Price
1MX9-80X3	1M x 9	80ns	SIMM	44.95
1MX9-60X3	1M x 9	60ns	SIMM	46.95
4MX9-80X9	4M x 9	80ns	SIMM	169.95
16MX9-70X9	16M x 9	70ns	SIMM	699.00
1MX36-70	1M x 36	70ns	SIMM	184.95
2MX36-70	2M x 36	70ns	SIMM	379.95
4MX36-70	4M x 36	70ns	SIMM	619.00

**Sales 1-800-538-5000**

**Toll-Free Fax Ordering  
1-800-538-5005**

**Local/International  
1-408-494-1400**

**Order  
24-Hours-A-Day  
By Phone or Fax**

KEY CODE 1069

TERMS: For shipping & handling include \$4.29 for ground & \$6.99 for 2nd day air. Orders over 1 lb. and foreign orders may require additional shipping charges—contact our Sales Dept. for the amount. CA residents must include applicable sales tax. Prices subject to change without notice. We are not responsible for typographical errors. We reserve the right to limit quantities and to substitute manufacturer. All merchandise subject to prior sales. A full copy of our terms is available upon request. Items pictured may only be representative. JDR, the JDR logo, JDR Microdevices, and the MCT logo are registered trademarks of JDR Microdevices. Modular Circuit Technology is a trademark of JDR Microdevices. Copyright 1995 JDR MICRODEVICES. Other trademarks are the property of their respective owners.



- 15" & 17" large screen Monitor Ergonomic layout of control panel with intelligent microprocessor digital control
- Innovative options include a multimedia base designed to fit all PC monitor

**A Special Choice  
for Multimedia Application**

ACTION provides a full range of monitors to choose from.

A special recommendation is the 17" home computer monitor with a large screen at reasonable price. For more information, call us today.



**ACTION ELECTRONICS CO., LTD.**

Head office

*Action Electronics Co., Ltd.*

198, Chung Yuan Rd., Chung Li Industrial Zone,  
Tao-yuan, Taiwan, R.O.C.

Tel.886-3-451-5494 • Fax.886-3-452-0697

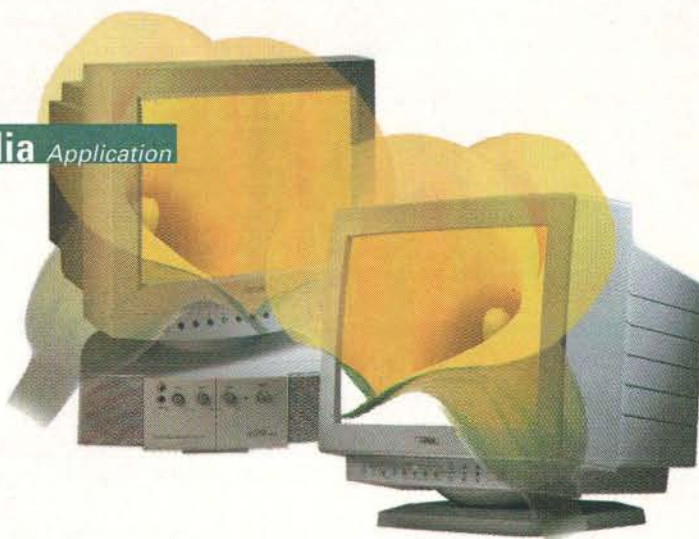
Taipei Sales Office Tel.886-596-5955 • Fax.886-2-5928138

U.S.A. Office

*Action Computer Technology Inc.* Tel.909-444-1300 • Fax.909-444-1308

European Office

*Axion Technology GmbH* Tel.49-2166-9527-0 • Fax.49-2166-9527-27



## MOVING?

To change your subscription mailing address, please complete the form below and send it to:

BYTE Magazine Subscriber Services  
PO Box 555, Hightstown NJ 08520

Fax: 609-426-7087

Phone (9 a.m. to 8 p.m., Eastern Time, Monday through Friday):  
800-232-2983 (U.S.) or 609-426-7676

**Current/Old Address:**

Account Number \_\_\_\_\_

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_

PLACE MAILING  
LABEL HERE

**New Address:**

Name \_\_\_\_\_

Company \_\_\_\_\_

Address \_\_\_\_\_

City/State/Zip \_\_\_\_\_

Please allow up to 8 weeks for this change to become effective.



Because the *Experts* decide.





**Computer Gate**  
is your international  
supersource for PC  
accessories,  
multimedia and  
network products.

**\$2.95**

**Power Strip**



**For a FREE Catalog call 408 730-0673**

Circle 203 on Inquiry Card (RESELLERS: 204).

## VGA Splitters



- Display your PC's screen on many monitors simultaneously
- Perfect for demos, training and remote monitoring
- Proven wideband amplifier assures bright and crisp image - **GUARANTEED!**
- Automatically access one PC from two keyboards with ease
- Quality monitor and keyboard extension cables available to 500 feet
- Exclusive video switches, multiplexers and other unique products

**HRT**

**HALL RESEARCH  
TECHNOLOGIES**

**800-959-6439**

714-641-6607 fax: 6698  
1506 Brookhollow Dr.,  
Santa Ana, CA 92705

*Celebrating Our 11th year!*

**Toll-Free Support  
One Year Warranty  
Quantity Discounts**

Circle 170 on Inquiry Card.

*We Want to Send You a*

# FREE!

**268 PAGE CATALOG OF DISCOUNT  
COMPUTER SUPPLIES & ACCESSORIES**

**Plus!**

We will add you  
to our mailing  
list for one year  
on a trial basis -  
in which time  
you will receive 4  
catalogs from the  
most unique  
company in  
our industry.

**LYBEN**  
COMPUTER SYSTEMS



5545 Bridgewood, Sterling Heights, MI 48310  
CALL US TOLL-FREE (800) 493-5777 or Fax (810) 268-8899

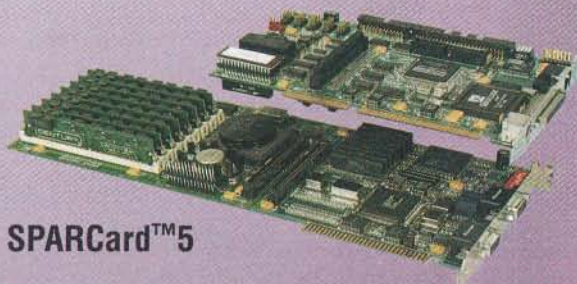
*Simply utilize the reader service number below -  
or call, write or fax us for your free catalog.*

Circle 210 on Inquiry Card.

## SPARCstation Power In Your PC!

*Elegantly provides  
PC users with a  
complete UNIX  
environment.*

*-Unix Review*



### SPARCard™5

- ▲ Complete SPARCstation 5 system on a PC/AT boardset
- ▲ Runs Solaris, SunOS
- ▲ Perfect for PC users who need to run DOS/Windows and Unix applications
- ▲ Available on GSA through Sparta, Inc. at 703-448-0210
- ▲ Prices starting at \$2,495

**OPUS**  
SYSTEMS

Call 408 • 562-9340  
Fax 408 • 562-9341  
3000 Coronado Drive • Santa Clara CA 95054

Circle 146 on Inquiry Card (RESELLERS: 147).

## SERIAL/PARALLEL I/O ADAPTERS

**RS-232/422/485 • Dual Serial  
Quad Serial • Serial/Parallel**

16550/16650 Buffered UARTs  
Flexible Address and Interrupt Capability

**Ask about our new PCI I/O Products!**



- Made in USA • Lifetime Warranty
- Unlimited Technical Support

**Globetek, Inc.**

3505 E. Royalton Rd. Ste. 160 • Broadview Hts., OH 44147  
800-229-4640 • 216-526-8550 • Fax: 216-526-8817

Circle 206 on Inquiry Card (RESELLERS: 207).

Let your **"TRUE COLORS SHINE  
THROUGH"** when you advertise your  
computer products in the

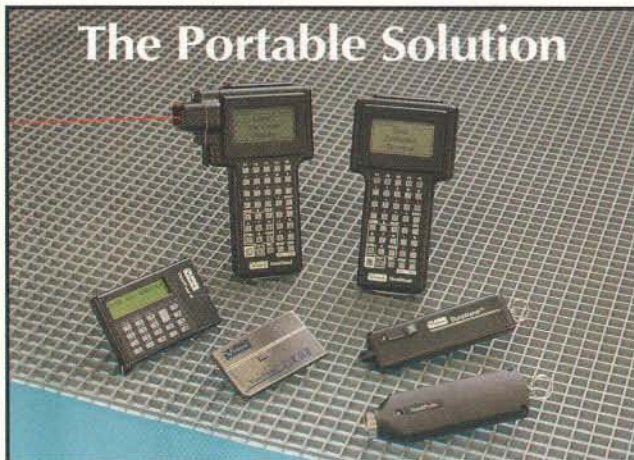
**BYTE**

**HARDWARE/SOFTWARE SHOWCASE**

**Call for more details:  
(603) 924-2695 or (603) 924-2598**



## The Portable Solution



Videx manufactures portable, durable, and programmable data collectors for applications such as:

- inventory • warehousing
- security • asset tracking
- field inspections

and virtually any application requiring data collection at the work site.

Cast-metal cases protect the products and allow them to work reliably in harsh environments. Each is designed to fit in the palm of your hand.



Call for a free information kit today!



1105 N.E. Circle Blvd., Corvallis, OR 97330  
503-758-0521 • Fax 503-752-5285

Videx, TimeWand, DuraWand, TouchProbe, and OmniWand are registered trademarks of Videx, Inc. CCO582

Circle 153 on Inquiry Card.

## Voice Boards from New Voice.

*Now the others are obsolete. (Scary, isn't it?)*

Computer Telephony Integration (CTI) is one of the fastest growing markets. Pick the voice board with performance that screams. Our sophisticated 2, 4, or 8 port models provide the best building blocks for success. Used in applications such as:

- Int'l Callback/Debit Card
- Interactive Voice Response
- Voice Mail/Messaging
- Automated Attendant
- Fax Back/On-Demand
- Tele-conferencing
- 800/900 Services
- Telemarketing
- Audiotex
- Talking Yellow Pages
- T1 Interface Support

1893 Preston White Drive  
Suite #120  
Reston, VA 22091

Tel (703) 648-0585  
Fax (703) 648-9430

**New**  
**oice**

Circle 178 on Inquiry Card.



## Computer Telephony Voice Cards Developer Kits

As a leader in Computer Telephony Integration platforms, PIKA is not only redefining technology standards but also the standards of vendor commitment to CTI software developers.

Contact us to find out about our latest offerings in DSP based multi-line voice cards with developer kits for DOS, Windows, OS/2 and NT.

### PIKA TECHNOLOGIES INC.

155 Terence Matthews Cres.  
Kanata, Ontario K2M 2A8, Canada  
Tel: 1-613-591-1555  
Fax: 1-613-591-1488  
Email: info@pika-pika.ca



Circle 166 on Inquiry Card (RESELLERS: 167).

## CONTROL ALL YOUR SERVERS

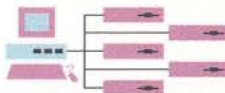
FROM ONE KEYBOARD, MONITOR AND MOUSE



**NEW**  
**Hot-Key**  
**Selection**

**MasterConsole®**  
Save space, time and money

- 2 - 64 Computers
- Any mix of PCs; PS/2 & Serial Mouse
- Add Mac & Sun
- Keyboard/Mouse Emulation
- AUTOSCAN™
- Front Panel & Keyboard Selection
- Remote Access to 150'
- Desktop or Rack Mount



**CALL TODAY! 800-RCI-8090 x 71**

RARITAN COMPUTER, INC. (908) 874-4072 Fax (908) 874-5274

10-1 Ilene Court, Belle Mead, NJ 08502 ■ sales@raritan.com ■ http://www.raritan.com

**30-DAY MONEY BACK GUARANTEE FULL 1-YEAR WARRANTY**

See Us at Network + Interop, Atlanta, Booth #4646 ■ See us at Networks Expo, Dallas, Booth #1790

INTERNATIONAL France: (33) 1-64 67 64 67 Germany: (49) 180-522-8222 Ireland: (353) 1-454-0589

Italy: (39) 2-66800548 Japan: (81) 3-3255-1517 Korea: (82) 2-412-5775

Netherlands: (31) 10-4423313 Sweden: (46) 020-788850 Switzerland: (41) 22-7532200

UK: (44) 244-520222 or (44) 344-424-333 RCI Taiwan: (886) 2-218-1117 RCI Europe (31)-10-4586-673

INTERNATIONAL RESELLERS INQUIRIES WELCOME — CONTACT RCI (908) 874-4072

Circle 172 on Inquiry Card (RESELLERS: 173).



## Rhetorex Voice Processing boards make CTI a reality.

If you're asking "what's CTI," you're missing one of the hottest new technologies going.

Computer Telephony Integration links PC-based computer applications to the telephone network, providing voice/fax mail, interactive voice response, voice/fax servers and more.

Interested? Maybe you're already developing a CTI application. Then it's time to discover Rhetorex.™

For the best value in CTI technology—from our 2 and 4 port DSP-based voice and fax processing boards, to our 24-port platform—give Rhetorex a call. And start making CTI a reality today.



RHETOREX

Rhetorex, Inc., 200 E. Hacienda Ave., Campbell, CA 95008-6617  
Tel. (408) 370-0881; Fax (408) 370-1171

All trademarks identified by the ™ symbol are trademarks of Rhetorex, Inc.  
All other trademarks belong to their respective owners. © 1993 Rhetorex, Inc.

Circle 150 on Inquiry Card.

### LET YOUR COMPUTER DO THE TALKING!

#### Integrated Voice/Fax Mail

integrates major voice/fax applications plus program control into one full-featured high performance software. PC-AT/386/486 based. Menu driven. Easy to use. Full support for Rhetorex, New Voice, Dialogic, Bicom, Pika, TTI and Intel voice and fax hardware. Supports up to 32 voice lines and up to 8 fax lines.

Hardware + Software Kits  
2 voice lines kit starts at **\$595**  
Fax-on-Demand lines: 818-368-4566 or  
818-368-8848

**SigmaTech Software**  
Tel: (818) 368-6132 Fax: (818) 368-7859  
10801 Bismarck Ave., Northridge, CA 91326 USA  
(Resellers/Dealers/OEMs/Private labels are welcome)

- Automated Attendant
- Unlimited Audiotext
- Voice Mail
- Talking Yellow pages
- Telemarketing
- Fax Mail
- Fax-on-Demand
- Fax Broadcasting
- Date/Party lines
- Int'l Call Back

Circle 158 on Inquiry Card (RESELLERS: 159).

## GET THE MESSAGE - OR ELSE!



### WINDOWS-BASED

- ◆ Voice Mail
- ◆ Auto-Attendant
- ◆ Fax-On-Demand
- ◆ Packages from \$295

**1-800-685-4884**

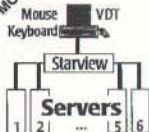
(Developer/OEM packages available) VISA - MC - AMEX - COD

Don't trade your life for a lost message!

**TALKING TECHNOLOGY, INC.**  
1125 Atlantic Avenue, Alameda, California, 94501  
Voice: 510-522-3800 Fax: 510-522-5556

Circle 152 on Inquiry Card.

**\$349.00**  
MONEY BACK GUARANTEE



## STARVIEW

PS/2 Model Available!

### Control up to 216 Servers

with just 1 Monitor, Keyboard, and Mouse

- Supports SVGA, VGA, and Multisync Monitors
- Pushbutton or keyboard CPU selection
- Rackmount bracket available • Autoboos CPUs
- Cascadable

Model SV621  
Controls 6 Servers  
\$349.00 - 110 VOLT CSA/UL



Rack Mount Available

USA/Canada: 800-265-1844 (ext. 231)

Fax: (519) 438-6555 / Internet E-Mail: startech.computer@onlinesys.com

**StarTech**  
COMPUTER PRODUCTS  
USA • Canada • UK •  
Germany • Hong Kong

European/International Distribution  
use Fax or Internet  
or Call: (519) 438-6529 (ext.231)

Visa/Mastercard/American Express

Circle 198 on Inquiry Card (RESELLERS: 199).

## Rackmount



- ENCLOSURES for 386, 486 & Pentium
- KEYBOARDS
- MONITORS
- DRIVE ENCLOSURES

**PC Enclosures**  
from \$300

**Monitor:**  
10" Super VGA  
Color from \$650

**Keyboards:**  
Drawer, Shelf &  
Panel from \$85

- Excellent Air Flow & Cooling
- Accepts Most Motherboards and Passive Backplanes
- Rack & Desk Models • Up to 20 Slots • Rugged, Modular Construction
- 200, 300 & 400 Watt Supplies, UL, CSA, TUV • Made in U.S.A.

Call or write  
for descriptive  
brochures, prices  
or applications  
assistance:

**INTEGRAND**  
RESEARCH CORP.

8620 Roosevelt Ave. • Visalia, CA 93291

209/651-1203 FAX 209/651-1353

PC™ IBM • 386/486 Pentium™ Intel • Drives and computer boards not included.

Circle 140 on Inquiry Card.

## PC SYSTEMS IN ROM

<p><b>KS-1</b> XT CPU card. NEC V40, 1 MB Dram, Sram, Flash, Pcmcia, 3 srl, 2 par, modem, A/D. <b>\$129 up</b></p> <p><b>KS-9</b> AT (F8680) battery operated CPU with 2M Flash, Sram, CGA contr., Pcmcia, 3 srl, 2 par. <b>\$249 up</b></p> <p><b>PC-in a-Box</b> Complete system with KS-9 CPU, 256K Psram, 192x128 LCD, 53 kypd, 1 srl, pwr sup, box. <b>\$399</b></p>	<p><b>Sales: 1-800-505-6749</b> <b>303-444-7737 • Fax 303-786-9983</b></p>
---	--

Circle 142 on Inquiry Card.



## Computer Systems • Data Acquisition

### INDUSTRIAL COMPUTER SYSTEMS



**NEW \$245**

**SRPC-210  
19" Rackmount Chassis**

- Locking front panel access
- AT M/B or 14 slot passive B/P
- Filtered positive air pressurization
- Shock-mounted drive bay
- Desk top version available
- \$265 with 250W P/S (UL, CSA & TUV) - optional

**Full Line of Rackmount Products**

Rackmount Systems:  
386 to dual pentium

Rackmount Chassis:  
Over 20 different models

Rackmount Monitors:  
5" to 20" (dual monitors avail.)

Rackmount Keyboards:  
Full travel, membrane

Drive Enclosures:  
Disk/CD array enclosures

Redundant P/S:  
Hot Swap up to 3 P/S

**Siliconrax**  
1050 E. Duane Ave. Bldg. I,  
Sunnyvale, Calif. 94086  
**1-800-700-8560**

Dealers & Distributors Welcome! Ask for Quantity Discounts!

Circle 187 on Inquiry Card.

## Rackmount Solutions

RACKMOUNT COMPONENTS - QTY 25 PRICING	
Rackmount Chassis 19"x7"x17"	\$131
Rackmount VGA Monitor	\$131
Rackmount Monitor Shelf	\$113
Rackmount Cherry Keyboard Drawer	\$200
RACKMOUNT PLATFORMS - Qty 1 Pricing	
RMS486DX2-66 EISA	\$1593
RMS486DX-33	\$1136
RMS486SX-33	\$915
RMS386SX-33	\$665

RACKMOUNT CHASSIS - 15 Models up to 20 Board Slots

SLOT CPU BOARDS - EISA/ISA 486, 486SX, 386, 386SX

RACKMOUNT MONITORS - Super VGA & Monochrome

RACKMOUNT KEYBOARDS - High Quality Cherry KB

RACKMOUNT SWITCH - VideoKB up to 12 CPUs

RACKMOUNT CABINET - Modular from 21" to 96" high

Exclusive International Distributor Program now Available

**VALLEY**  
TECHNOLOGY INC.

2468 Armstrong Street, Livermore CA 94550  
(510) 447-2030 FAX: (510) 447-4559



Circle 156 on Inquiry Card.

## Industrial PC Solutions



Rackmount PCs

Industrial PC Chassis

Industrial Workstations

Panel Display PCs

Pentium/486/386 CPU Cards

RS-232/422/485 Interface

Analog and digital I/Os

Data Acquisition

Call **800-800-6889** to receive a **FREE** 100-page Solution Guide for your OEM or system integration needs.

**ADVANTECH.**

750 E. Arques Ave.  
Sunnyvale, CA 94086  
408-245-6678, Fax 408-245-8268

Circle 136 on Inquiry Card.

## Data Acquisition

## 8 BIT, 250 MSPS A/D Card



- ✓ 12 bit, 60 MSPS A/D
- ✓ 8 bit, 250 MSPS A/D
- ✓ Up to 16 Meg Memory
- ✓ Drivers in C, BASIC, Windows DLL, LabVIEW, LabWindows CVI

CSLITE	8 bit, 40 MSPS	\$595
CS250	8 bit, 100 MSPS	\$3500
CS2125	8 bit, 250 MSPS	\$4995
CS1012	12 bit, 20 MSPS	\$4995
CS6012	12 bit, 60 MSPS	\$6995

U.S. Prices. International prices may vary.

**GaGe**  
1-800-567-GAGE

Gage Applied Sciences Inc.

5610 Bois Franc, Montreal, QC, Canada H4S 1A9  
From outside North America, call +1-514-337-6893  
Fax: (514) 337-8411, BBS: (514) 337-4317

Circle 138 on Inquiry Card.

## Portable Industrial Data Acquisition

Includes Electrical Isolation

- Printer-port connection
- 1500 volts isolation
- 8 voltage/current inputs
- 1 frequency input
- 16 bit A/D, 1 ksp/s/input
- AC or battery power
- Stand alone operation
- Complete in one unit

Industrial/Commercial use only



**Innovation Industries Inc.**

Olympic Towers, 300 Pearl St., Suite 200, Buffalo NY 14202 • (716) 842-4558  
251 Brighton Ave., Toronto, Canada M3H 4E8 • (416) 636-0052 • Fax (416) 636-7738

Circle 182 on Inquiry Card (RESELLERS: 183).

Portable Data Acquisition  
for Notebook PCs

Measure volts, thermocouples, RTDs, strain gages, isolated high voltage, and more—up to 256 channels at 10 µsec/channel. DOS, Windows, and icon-based software support included.

From \$695



12- or 16-bit 100 kHz DaqBooks™

High-speed PCMCIA or parallel port connection



the smart approach to instrumentation™

IOtech, Inc. • 25971 Cannon Rd. • Cleveland, OH 44146

(216) 439-4091  
Fax (216) 439-4093

Circle 141 on Inquiry Card.

NEW 23-bit A/D  
offers both  
HIGH SPEED and  
HIGH RESOLUTION

at an affordable price **\$1295**

Call now to order or for information about our complete line of Data Acquisition Products.  
PHONE 800-444-5355 FAX 406-257-5572

- Maximum Data Rate 5400 Samples/Sec
- Linearity 0.0004% of Full Scale Typical
- Standard Parallel Printer Port Interface
- 20 Digital I/O Lines
- Input Impedance 100,000 Megohms
- Expandable to 96 Channels

**Lawson Labs, Inc.**  
15 Years of Quality

Circle 144 on Inquiry Card.



## The Intelligent Solution For Data Acquisition



DAP 3200e™ Data Acquisition Processor™

Analog I/O to 769K samples per second  
Digital I/O to 1.6M samples per second  
Up to 512 analog inputs on one DAP™  
Up to 128 digital inputs on one DAP™  
Up to 66 analog outputs on one DAP™  
Up to 1024 digital outputs on one DAP™

On-board 486: SX, SX2, DX2, or DX4  
Real-Time Data Acquisition—Windows or OS/2  
Real-Time Process Control—Windows or OS/2  
On-board FFT, FIR, PID,  
and more  
VBX Custom Control

206-453-2345 / fax 206-453-3199

info@mstarlabs.com

http://www.mstarlabs.com/mstarlabs/

MICROSTAR

LABORATORIES

2265 116th Avenue NE  
Bellevue, WA 98004

## LOW COST/FAST A/D BOARD

Model AD-8H50AT for PC/AT ISA Bus

- 50 MSPS, 8 bit
- \$3,595 with 1 MB
- Up to 4 MB Memory
- Versatile Function
- Easy Programming
- Free Demo Program



THAMWAY

Worldwide agent - Sci Tran Products

1734 Emery Drive, Allison Park, PA 15101 U.S.A.

Tel: (412) 367-7063 Fax: (412) 367-7063

Headquarters - Thamway Co., Ltd.

3-9-2 Imaizumi, Fujishi, Shizuoka 417 JAPAN

Tel: (0545) 53-8965 Fax: (0545) 53-8978

Circle 211 on Inquiry Card.

## GO-WHERE YOUR DATA IS

Micropower, Ultra Small  
Data Acquisition

AdcDongle12A 8 Channels \$89

Special Factory Direct Price \$119

- PC Serial Port DB25 Interface
- Self-Powered Model, no batteries
- 12 bit 10us A/D, Linear PCM, 4V FS
- 1 to 64 Channel, 4-20mA input models
- Latest ICs, Surface Mount Technology
- 8 Channel Waveform Viewer/Editor \$75
- DOS Libraries + VB DLL \$15 and up

Call for Free Information - Other Portable Products Also

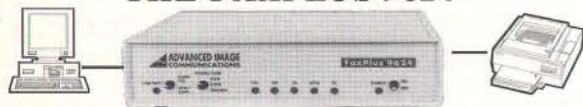
SiliconSoft 800-969-4411 Ph: 408-446-4521  
4760 Castlewood Drive, San Jose, CA 95129 Fax: 408-446-5196

Circle 151 on Inquiry Card.

## SMART FAX MODEM?

Yes, a fax modem that works with your PC off!!

THE FAXPLUS 9624



- ✓ STORES FAXES IN MEMORY
- ✓ VIEW FAXES BEFORE PRINTING
- ✓ AC OR BATTERY OPERATION
- ✓ COMES WITH FREE SOFTWARE
- ✓ SUPPORTS CAS APPLICATIONS
- ✓ SEND FAXES WITH ANY SCANNER
- ✓ V.42, MNP DATA MODEM
- ✓ UP TO 16MB OF MEMORY
- ✓ USE YOUR EXISTING PRINTER
- ✓ AND MUCH, MUCH MORE!!

ADVANCED IMAGE COMMUNICATIONS

3343 D VINCENT RD. PLEASANT HILL, CA 94523 USA Ph: 510-947-1000/FAX 1900

Circle 176 on Inquiry Card (RESELLERS: 177).

## Terminate SCSI Problems

## SCSIVue™ Active Terminator

## Benefits:

- Improves SCSI Bus Performance
- Less Errors; More Reliable Data Transfer
- Diagnoses Problems • Analyzes Signal Quality

## Features:

- Active Regulation
- Status Indicators • Gold Contacts



From: \$59

Optional Remote Display



From: \$39

## SCSIVue™ Gold Diagnostic Cables

## Benefits:

- No Loss Of Important Data
- Faster Performance • Test Cable Integrity

## Features:

- Diagnostic Indicators • Large Ferrite Filters
- Triple Shielding (Unique Cable Design)
- Double Gold 20u" Plated Connectors
- Extra Heavy 26 Gauge Wire

## SCSIVue™ Teflon Internal Cables

## Benefits:

- Less Errors, Ultimate Performance
- Silver Wire Improves Signal Quality

## Features:

- Perfect 90 Ohm Impedance Match
- Triple Pronged Connector With Gold contacts



From: \$39

The SCSI Solution Company

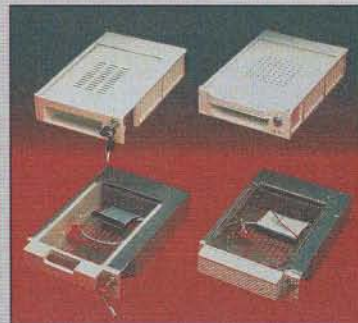
Granite D-I-G-I-T-A-L

3101 Whipple Rd., Union City, CA. 94587

Ph: 510-471-6442 Fax 510-471-6267

Circle 160 on Inquiry Card (RESELLERS: 161).

## REMOVABLE STORAGE MODULES



## FEATURES &amp; OPTIONS:

- Supports most 3.5" hard drives
- IDE, or SCSI interfaces
- Hot removability
- Key lock ON/OFF security
- Fan cooling option
- Built-in SCSI ID selector switch option
- Ruggedized aluminum or low-cost plastic version
- Power/Drive activity LEDs
- Patent protected

## RUGGED RACKMOUNT KEYBOARDS



- 19" rackmount keyboards
- 1U or 1.75" space
- 25 models
- Full travel and membrane types
- IBM PC XT/AT, PS2 compatible
- US and Intl. versions
- Spring-lock front panel
- Serial output 16mm, 2 button trackball

Call Elma at  
510-656-3400

ELMA

ELMA Electronic Inc.  
44350 Grimmer Blvd.  
Fremont, CA 94538  
Tel: (510) 656-3400  
Fax: (510) 656-3783Circle 174 on Inquiry Card  
(RESELLERS: 175).

SEPTEMBER 1995 BYTE 313



Keyboards • LAN Hardware • Laptops &amp; Notebooks

## CUSTOMIZE YOUR KEYBOARD

- Custom Key Imprinting - all brands!
- Custom Colored keys for IBM®, DEC®, Wyse®, Key Tronic®, Cherry®, and more!
- Custom and stock keytop label kits for software support & languages.
- Full color keyboard templates made to your exact specifications.
- Word Perfect Keyboards.
- Cyrillic, Arabic, Hebrew, etc. Keyboards



**CUSTOM HOTLINE 800 937-1337**  
from the leader in Keytop Innovations™ Dept. BYTE, 260 Justin Dr.  
Cottonwood, AZ 86326

**Hooleon**  
CORPORATION

520 634-7515  
FAX 520 634-4620

Circle 139 on Inquiry Card.

ZERO DOWN TIME SERVER SOLUTION  
w/ Hot-Swap Redundant Power Supply

## 18 Bay File Server Case

- 8 Open Drive Bays
- Removable Motherboard Rack
- 3 System Cooling Fans



## Hot-Swap Redundant Power Supply

- Load-Sharing Design
- Power Fault Alarm/LED/Signal
- N+1 Redundancy

Also available other Server &amp; RAID Cases



**ANTEC**  
INCORPORATED

2859 Bayview Drive, Fremont, CA 94538  
(510) 770-1200 ext 313 Fax (510) 770-1288

Circle 202 on Inquiry Card.

# Laptop/Notebook UPGRADES

CPU and Hard-drive Upgrades  
for all major brands.

- 486SLC2 clock-doubled CPU upgrades for 286/386SX's  
- IBM 486SLC2 (with 16KB cache) for true 486 performance.
- 386DX to IBM 486BL3 clock-tripled CPU upgrades.
- i486SX/DX to i486DX4 clock-tripled CPU upgrades.
- Upgrade-packages (CPU & hard-drive) from \$495.00  
- Packages include installation, file transfer & return shipping.

Request our new Upgrade Guide  
Now available! 486 upgrades for most IBM PS/2 models.

**CORPORATE**  
Upgrades, Inc.

**(800) 240-6190**

US/Canada: Tel: (916) 536-3710 Fax: (916) 536-3719 P.O. Box 289, Fair Oaks, CA 95628

Europe: Tel: (+46) 8-751-7668 Fax: (+46) 8-751-4601 Box 1189, Kista, Sweden

All trademarks are the property of their respective owners.

Circle 200 on Inquiry Card  
(RESELLERS: 201).

Laptops &amp; Notebooks • Mail Order • Memory/Chips/Upgrades

The **LIGHTEST** desktop-to-go PC

**EduCALC**  
27953 Cabot Road  
Laguna Niguel, CA 92677  
Fax: 714-582-1445

## The OmniBook 600C

- Color 8.5" display
- DOS 6.2, Windows 95 ready
- 2 PCMCIA card slots
- Full-size keyboard
- Pop-up mouse
- Only 3.8 lbs!

**CALL TODAY FOR  
PRICING & CATALOG  
800-713-6525**

Circle 162 on Inquiry Card.

**if** you were thinking of expanding your storage or adding a CD-ROM, you might want to give us a call.

We specialize in expansion housing, from one 3-1/2" portable, or one 5-1/4" "Mac" 2FP all the way up to eighteen 5-1/4"HH.



**CALL US FOR A PORTFOLIO TO ORDER 800-75-WETEX**  
OUTSIDE CALIFORNIA 93839

**WETEX INTERNATIONAL (USA) CORP.**

1122 W. Washington Blvd., Suite D, Montebello, CA 90640  
Tel: (213) 728-3119, Fax: (213) 728-3203

Circle 213 on Inquiry Card.

## SIMMVERTER™

Save \$100s in memory when upgrading to newer PC Systems!

SimmVerter™ converts your old 30 pin SIMMs to 36 bit, 72 pin connector SIMMs...

**...for only \$19 \***

- ✓ Converts four 1MBx9 SIMMs to one 1MBx36 SIMM (4MB).
- ✓ Converts four 4MBx9 SIMMs to one 4MBx36 SIMM (16MB).
- ✓ Guaranteed to work in any system using 36 bit memory.
- ✓ Works along with other 36 bit and even 32 bit SIMMs.
- ✓ Up to 4 adapters can be installed side by side.
- ✓ 4 models to choose from to fit any system.
- ✓ Patented and designed in the USA.



**To Order call 1-800-440-7466**

OEM, dealer & distributor inquiries welcome!

\* Price per adapter. Add \$5 for shipping and handling and sales tax where applicable.

Circle 196 on Inquiry Card (RESELLERS: 197).

**BYTE**

**Breaks the 4-Color Price Barrier  
with the Hardware/Software Showcase**

See how affordable it is to advertise to BYTE's  
500,000 computer professionals in this section!

Call for more advertising information:  
**(603) 924-2695 or (603) 924-2598**



## SIMMSTACK™

### 30pin to 72pin SIMM Conversion



✓ Install four 30pin SIMMs into one 72pin Slot  
 ✓ Also Available: Install two 72pin SIMMs in one 72pin slot

**SERMAX** **800-209-7126**

1751 Second Ave., New York, NY 10128 Tel: (212)410-1597 Fax: (212)410-0452

**yes**  
It runs with NoWare

Circle 208 on Inquiry Card (RESELLERS: 209).

## ROM BIOS UPGRADES

### AUTHORIZED AMI & MR BIOS DISTRIBUTORS!

Buy with confidence from one of the largest and most knowledgeable BIOS distributors. Most with features such as:

- USER DEFINABLE DRIVE TYPES
- ENHANCED IDE SUPPORT
- LBA (> 528MB) SUPPORT
- 32-BIT BLOCK MODE TRANSFER
- SETUP BUILT-IN ROM
- 100% IBM COMPATIBILITY
- PASSWORD PROTECTION
- SUPPORT FOR UP TO 4 DRIVES
- BOOT SEQUENCE SELECTION
- GUARANTEED LOWEST PRICES!

Full documentation & support included for hassle-free installations.

### MAINBOARDS / DRIVES / MEMORY / & MORE...

**CALL NOW!**

**TTi** TTI Technologies Inc. 805-650-2030  
 1445 Donlon St. #9 Fax: 805-650-6515  
 Ventura, Ca. 93003

**1-800-541-1943**

BB# # 1-805-650-2045

CALL FOR FREE CATALOG!

Circle 163 on Inquiry Card.

## CD-R DESKTOP DUPLICATOR

### "ONE TO ONE SR-4100T" greatly helps on your multimedia solution!

Features:

- 4X Speed duplication
- Hard drive to 2 discs simultaneously
- Bit to bit comparison
- Interactive easy operation
- As PC external drive
- Network up to 10 units
- Single drive type available (SR-4100S)

Supported Formats:

- CD-ROM Mode 1
- CD-ROM Mode 2
- CD-DA, CD-I
- Mixed Mode
- CD-ROM XA Mode 2 Form 1
- CD-ROM XA Mode 2 Form 2
- VIDEO CD
- Hybrid
- ISO9660, HFS, UFS
- Single Session
- Multi Session

**18min/disc**



HOEI SANGYO CO., LTD.  
 TEL: 81-3-3665-3418 FAX: 81-3-3661-9147  
 12-15 NIHONBASHI-KOBUNACHO CHUO-KU, TOKYO 103 JAPAN

DISTRIBUTOR  
 LSK Data Systems GmbH — GERMANY —  
 TEL: 49-6071-24077 FAX: 49-6071-24079

Circle 191 on Inquiry Card (RESELLERS: 192).

## LINK YOUR PC TO THIS "PC"!



- Download your .EXE file
- Flash! Program is Installed

Only Micro/sys delivers embedded PCs this easy to use. CPU, RAM, FLASH, serial ports, I/O. V40 through 486. All ready-to-run. On-board firmware loads .EXE files into RAM for debug, or into flash for your final system. No hidden development costs. Save time & money — right out of the box. Starting at \$235. Qty 1.

**FREE!** 284 pg. Catalog

(818) 244-4600 • FAX (818) 244-4246

**MICRO/SYS**

Circle 193 on Inquiry Card.

To Subscribe to BYTE magazine, or for Customer Service, contact your local BYTE Subscription Representative:

**Benelux**  
 Gerry Westerhof  
 Phone: 31 2209 1855  
 Fax: 31 2209 1145

**France**  
 Eric Le Quinio  
 Phone: 33 1 49 77 03 06  
 Fax: 33 1 43 76 74 29

**Germany**  
 Wolfgang Brezina  
 Phone: 49 89 525 847  
 Fax: 49 89 529 850

**Greece**  
 Maria Hadjioannou  
 Phone/Fax:  
 30 61 272072

**Hungary**  
 Imre Szabo  
 Phone: 36 76 488888  
 Fax: 36 76 488889

**Ireland**  
 Ian Bangham  
 Phone: 353 1 2859609  
 Fax: 353 1 2857370

**Italy**  
 Enrico Campia  
 Phone: 39 11 8127656  
 Fax: 39 11 8127744

**Middle East**  
 Zafar Inamdar  
 Phone: 971 4 606788  
 Fax: 971 4 621149

**Poland**  
 Wlodek Binczyk  
 Phone: 48 2 625 22 75  
 Fax: 48 2 628 16 14

**Portugal**  
 Manuel Neves  
 Phone: 351 1 3479301  
 Fax: 351 1 3475127

**Scandinavia**  
 Lauge Dehn  
 Phone: 45 86223188  
 Fax: 45 86228159  
 or Gunnar Sandberg  
 Phone: 45 42803341  
 Fax: 45 45805579

**South Africa**  
 MAST Publications  
 Phone: 27 11 8804988  
 Fax: 27 11 4428327

**Spain**  
 Publitrade  
 Phone: 34 1 733 7346  
 Fax: 34 1 733 8970  
 or Eduardo Montojo  
 Phone/Fax: 34 1 57 16685

**Turkey**  
 Cengiz Eren  
 Phone:  
 90 2 16 345 3473  
 Fax: 90 2 16 346 2464

**United Kingdom**  
 Peter Gregson  
 Phone: 44 61 430 3423  
 Fax: 44 61 494 6976  
 or  
 John Luker  
 Phone: 44 258 821114  
 Fax: 44 258 821115

If there is no BYTE representative listed above for your country, please contact:

**BYTE Subscriber Services:**  
 PO Box 72, Galway,  
 Ireland.

**Fax:**  
 +1 353 91 752793.  
**Phone:**  
 +1 353 91 752792.

**BYTE**



## Multimedia

At Boxlight, you get the exact system for your needs. We have over 50 models in stock, so you aren't limited to just a few products. Your order is shipped in less than 24 hours, worldwide. Buying

**Affordable Color. Classy Package**

- Highest color at any price
- New faster response time
- Compact, portable design
- Free remote & cables
- Mac or PC Compatible

**\$1999**

Boxlight ColorShow™ 1200

presentation equipment doesn't get any more convenient. And our 30-day money-back guarantee means there's absolutely no risk. So why wait? Pick up the phone. Call today!

**CALL FOR OUR LATEST SPECIALS!**

**CALL BOXLIGHT!**

**1-800-762-5757**

Monday through Friday, 9am-5pm, Pacific Time

Connecticut (800) 497-4404 • California (800) 724-0154  
International (800) 724-0154 • Illinois (800) 724-0154 • Fax (800) 724-0154

Why buy from Boxlight Direct? • Immediate delivery with knowledgeable people the first time you call. • Immediate help in making the most appropriate equipment for your unique situation. • Free on-site delivery of over 50 models. • Immediate service of everything we sell by our in-house service group. Industry leading Lifetime Assurance Program. • Immediate overnight delivery to multiple world wide locations. • Hassle-free 30 day money-back guarantee. • Rentals. • Free lifetime after-the-sale technical support should you have any questions. • Call today and ask for a FREE catalog

**BOXLIGHT DIRECT**

VISA MasterCard American Express

Circle 185 on Inquiry Card (RESELLERS: 186).

**IF WE DON'T SELL IT, IT'S NOT WORTH LOOKING AT.**



**PANELIGHT IS YOUR ONE STOP SHOP FOR ALL LEADING BRANDS • SALES, RENTALS, & LEASES MONEY-BACK GUARANTEE • OVERNIGHT SHIPPING.**

PANELIGHT OFFERS THE BEST IN SELF-CONTAINED LCD PROJECTORS, LCD PROJECTION PANELS, SUPER-BRIGHT OVERHEADS, MULTI-MEDIA MONITORS, AND ACCESSORIES FROM THE WORLD'S LEADING MANUFACTURERS; HITACHI, IN FOCUS, PROXIMA, NEC, NVIEW, POLAROID AND OTHERS.

**CALL THE EXPERTS AT PANELIGHT DISPLAY SYSTEMS, INC.**

**CALL PANELIGHT FOR OUR FREE CATALOG: 1-800-726-3599.**

MON.-FRI., 6:30AM-5:30PM P.S.T.  
24-HR. FAX: 415-986-3817

PANELIGHT DISPLAY SYSTEMS, INC.,  
P.O. BOX 190940,  
SAN FRANCISCO, CA 94119.  
OR CALL 415-772-5800.

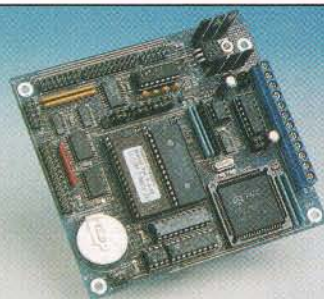
**Panelight**  
DISPLAY SYSTEMS, INC.

Circle 212 on Inquiry Card.

## Programmable Hardware • Tape Drives • UPS

**Smart Stuff!**

Low-cost miniature controllers, rich in features, with integrated C-language development system for fast project completion. Call our AutoFAX 916-753-0618 from your FAX. Request catalog 18.



**ZWORLD**  
ENGINEERING

1724 Picasso Ave.  
Davis, CA 95616  
916.757.3737  
916.753.5141 FAX

Circle 155 on Inquiry Card.

## Tape Solutions

...The Tape Experts



• **9 TRACK**  
• **3480 • 3490 • 3490E**  
• **LIBRARIES**

**Qualstar Corporation**  
6709 Independence Avenue  
Canoga Park, CA 91303

FAX (818) 592-0116 TEL (818) 592-0061  
(800) 468-0680

Circle 149 on Inquiry Card.

## PC/Mainframe/Mini Information Exchange



- Tape Transfer and Format Conversion
- EBCDIC ↔ ASCII Data Manipulation
- AS/400, TK50, and 14" QIC Drives
- UNIX Tar and DEC Save Set Options
- Reseller Inquiries Invited

**QUICKCOPY™ Tape Duplication**

**READ/WRITE 9-TRACK**  
**3480 • 8MM • DAT on**  
**YOUR PC NOW!**

Call Us ... (317) 842-2077 or

**SHAFFSTALL CORPORATION**  
FAX: (317) 842-8294

**1-800-248-3475**

Media Conversion Systems Since 1973

Circle 168 on Inquiry Card (RESELLERS: 169).

250W/+24VDC Input

250W/-48VDC Input DC-to-DC Converter

Contact us for +12VDC input model !!

- ACE-925T: -40VDC to -57VDC
- ACE-925C: 18VDC to 30 VDC
- Input protection against wrong polarity
- Operating Temp: 0 C ~ 50 C
- Storage Temp: -40 C ~ +75 C
- Dimensions: 5 7/8 X 5 1/2 X 3 1/2

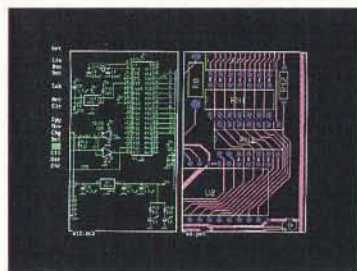


**ACI**  
SYSTEMS

Western Region: 1-800-983-1177  
Eastern Region: 1-800-886-2243

Circle 194 on Inquiry Card (RESELLERS: 195).





**WINTK**  
(800) 742-6809

Wintek Corporation  
1801 South Street  
Lafayette, IN 47904

**HiWIRE® II Schematic and PCB Software**  
With support for expanded and extended memory, HiWIRE II can handle your most demanding schematic and PCB designs. The unique HiWIRE II editor allows you to display and edit schematics and PCBs simultaneously, using the same commands for each. HiWIRE II is \$995, and is guaranteed.  
Call (800) 742-6809 or (317) 448-1903

Circle 154 on Inquiry Card.

**Talkie™ INTEGRATED I.V.R.**

- INTERNATIONAL CALL BACK
- LONG-DISTANCE RESELLER
- PREDICTIVE DIALERS
- DATE-LINES | CHAT LINES
- CONFERENCING

**BUNDLE 4 PORTS-\$715**

- VOICE-MAIL
- AUTO-ATTENDANT
- FAX-ON-DEMAND
- AUDIOTEX
- OUTDIALING
- TELEMARKETING
- APP-GEN & MORE

**"Very good product for VARs"**  
Computer Telephony, Mar 94

U.S.: 1-800-TALKIE4 Fax: 716-855-2244 CAN: 416-665-7638

Circle 189 on Inquiry Card (RESELLERS: 190).

## Factory Data Collection



The TransTerm 5 is a work station data entry/display terminal for on-line shop floor data collection into PC/AT/PS-2 systems. The unit is one of a family of such terminals which feature LC displays for operator prompting and data entry via sealed touch keys or an optional barcode scanner or badge reader (Code39, UPC+). A multi-terminal network controller (up to 250 stations) and a dBASE IV compatible software package are also available. System costs start below \$300 per station. Options include display backlighting, barcode scanning, counter inputs, control output.

**COMPUTERWISE®**

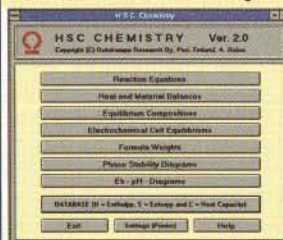
302 N. Winchester • Olathe, KS 66062

913-829-0600 • 800-255-3739 • FAX 913-829-0810

Circle 137 on Inquiry Card.

## HSC Chemistry for Windows

New ver.  
**2.0**



Chemical reaction and equilibrium software, which automatically utilizes an extensive thermochemical database equivalent to more than seven thick data books. The new version 2.0 is now available with many new features and larger database.

Ask for a color brochure:

**Outokumpu Research Oy**

P.O. Box 60, FIN-28101 Pori, Finland

Fax: +358-39-626-5310 Tel: +358-39-626-6111

Circle 164 on Inquiry Card (RESELLERS: 165).

**PC TEX**

For High-Quality  
Scientific Publishing,  
use PCTEX  
Typesetting Software.

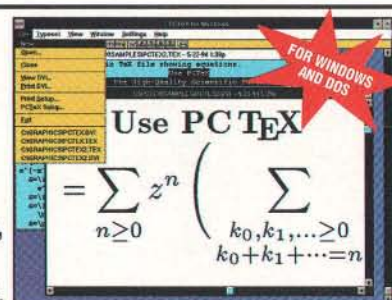
Make all your documents and math formulas look their best!

For a free brochure & demo disk, call 800/808-7906

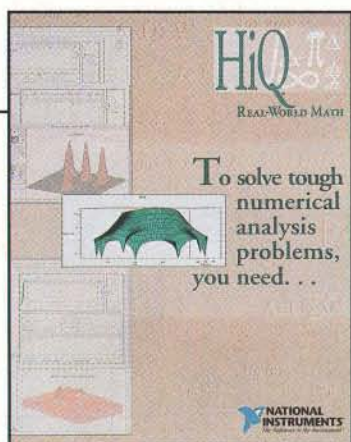
Personal TEX, Inc. 12 Madrona Street, Mill Valley, CA 94941

Fax: 415/388-8865 E-mail: pti@crl.com

Circle 148 on Inquiry Card.







## Numerical Analysis Software

Free HiQ numerical analysis and data visualization demonstration software for Macintosh. The demonstration package includes the HiQ demo program and an 84-page step-by-step demonstration manual that gives the user a comprehensive look at HiQ. Example problems include: signal processing, ordinary differential equations, linear algebra, numerical integration, and 3D visualization.

### National Instruments

6504 Bridge Point Parkway, Austin, TX 78730  
(512) 794-0100  
(800) 433-3488 (U.S. and Canada)  
Fax (512) 794-8411

Circle 145 on Inquiry Card.



## Create FORMS for Windows or DOS applications

Integrate forms, logos, fonts, graphics, signatures, into Visual Basic, C/C++, FoxPro, Clipper, Clarion, programs. Visual Forms, in a Windows environment, creates PCL or metafile. Use Template Maker to position your X,Y coordinates for your data fields.

Custom and stock forms available. Digitized logos, signatures.

**BYTECH**

(914) 354-8666

**BUSINESS SYSTEMS, INC.**

5C Medical Park Dr.

Pomona, NY 10970

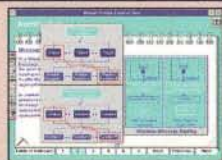
Circle 157 on Inquiry Card.

## Learn C++ & Windows™-Based Programming...

*Simply, Quickly!*

With the OML Learning Series™ you can learn C/C++, object technology and Windows™-Based programming quickly and conveniently in the privacy of your home or office. The OML Learning Series features:

Visual Series™,  
C/C++ Series™,  
OOA/OOD Series™,  
OLE Series™



Each series: \$249\* (reg. \$400)  
Any 2 series: \$399\* (reg. \$750)  
Any 3 series: \$549\* (reg. \$1050)  
All 4 series: \$649\* (reg. \$1300)  
LAN version: Call  
\* Limited Time Offer

**800-6789-OML**

Call us for information, and FREE Demo Software

Visa  
MC  
Amex

**OBJECT MANAGEMENT LABORATORY**

TEL: 805-373-8111  
FAX: 805-373-8116

Circle 184 on Inquiry Card.

# Don't Be the Only One Using FORTRAN 77

You look around and discover everyone is making the move to LAHEY FORTRAN 90. Except you. You're using Fortran because it is proven, portable, and the best language for numerically intensive programs. But why 77? With Lahey Fortran 90, you can run your FORTRAN 77 programs FASTER and take advantage of the new language feature in 90.

Array expressions, more intrinsic functions, structures, pointers, better array handling, and modules are just a few of the reasons to move to Lahey Fortran 90. Use these and other features to build new, faster executing 32-BIT applications with fewer lines of code. But even if you are not writing new code, the design and speed of Lahey Fortran 90 are reasons enough to switch.

Lahey's innovative compiler design combined with Intel Corporation's highly OPTIMIZED code generation technology produces a language system optimized from the chip up. Lahey Fortran 90 is the fastest PC Fortran on the Pentium—over 18 Mflops on a 90 MHz (SP Linpack). And, you get all the TOOLS found in our award-winning (ahem) FORTRAN 77 language systems: editor, debugger, profiler, librarian, make, linker, video graphics, and Phar Laps's royalty-free DOS-Extender—everything you need to write or port 4GB programs. Add to this our decade of writing PC Fortrans and free technical support. So, don't be the last one using FORTRAN 77, make the move to Lahey Fortran 90.

\$895

Call 800 548-4778 for more information on our Fortran language systems

**Lahey**  
Computer Systems, Inc.

Fortran is our forte

702 831-2500 • Fax: 702 831-8123

Circle 143 on Inquiry Card.

Got Fuzzy Numbers? **NEW!**

Conventional spreadsheets can't cope with uncertain or fuzzy numbers.

But now there's FuziCalc. This Windows spreadsheet uses revolutionary fuzzy math technology to achieve breakthrough performance.

Call now for FREE information.

800-472-6183

**FuziCalc.**  
The Fuzzy Spreadsheet™

**FuziWare, Inc.**  
(615) 588-4144

Circle 181 on Inquiry Card.

**NEW RELEASE**

**Japanese / English Machine Translation via Internet "InTransNet"**

- Automatically translate e-mail messages to English / Japanese
- For detail, please check our WWW home page: <http://www.intransnet.bc.ca>

Call for details

**KUREO TECHNOLOGY LTD.**  
303-3600 Gilmore Way,  
Burnaby, B.C. V5G 4R8 CANADA  
Tel: (604) 433-7715 Fax: (604) 433-3393  
inq@intransnet.bc.ca

**KCOMS For Windows 95**  
-Japanese word processor for MS-Windows.  
-With OLE2.0 server feature, you can insert Japanese on English applications.

**PC Transfer**  
-High end Japanese/English machine translation program.  
-Incredible translation speed.

日本語ソフトウェア

Circle 179 on Inquiry Card (RESELLERS: 180).



# THE BUYER'S MART

## A DIRECTORY OF PRODUCTS AND SERVICES

THE BUYER'S MART is a unique classified section organized by product category to help readers locate suppliers. Each ad has Inquiry numbers to aid readers requesting information from advertisers.

**AD FORMAT:** Each ad will be designed and typeset by BYTE. Do NOT send logos or camera-ready artwork. Advertisers should furnish typewritten copy. 2"x1 1/8" ads can include headline (23 characters maximum), descriptive text (300 characters is the maximum recommended) plus company name, address, tele-

phone and fax number. 2"x2 1/4" ad has more space for descriptive text (850 characters is the maximum recommended).

**DEADLINE:** Ad copy is due approximately 2 months prior to issue date. For example: November issue closes on September 6. Send your copy and payment to: **THE BUYER'S MART**, BYTE Magazine, 1 Phoenix Mill Lane, Peterborough, NH 03458. For more information call: **Ellen Perham at 603-924-2598** or **Mark Stone at 603-924-2695**. **FAX: 603-924-2683**.

### RATES (Jan. 1995)

		3-5 Issues	6-11 Issues	12 Issues
1 ad	\$731	\$701	\$614	
2"x1 1/8"	2 ads/issue	-	-	584
	3 ads/issue	-	-	556
1 ad	\$1,462	\$1,402	\$1,228	
2"x2 1/4"	2 ads/issue	-	-	1,169
	3 ads/issue	-	-	1,111

\*\*\*\*\*COLOR - Add \$100\*\*\*\*\*

## ACCESSORIES

### KEYBOARD, VIDEO, MOUSE, AUDIO

Extend signals from PC with **EXTENDER**  
Split signals with **COMPANION/PC EXPANDER**  
Switch signals among PCs with **COMMANDER**  
Boosts signals up to 600 feet. Control up to 96 PCs with one keyboard, monitor and mouse.

### CYBEX CORPORATION

4912 Research Dr., Huntsville, AL 35805  
**Phone: 205-430-4000 Fax: 205-430-4030**

Inquiry 651.

### STABILANT 22 CONTACT ENHANCER

*"Highly recommended..." Jerry Pournelle*

A long-term environmentally-safe, resident contact treatment; Stabilant 22 substantially improves the reliability of connectors and contacts for computers, bio-medical electronics, telecom, avionics, process control, CATV, video, audio, and automotive equipment.

### D.W. Electrochemicals Ltd.

97 Newkirk Road (North) Unit 3, Richmond Hill, Ontario L4C 3G4, Canada (905) 508-7500

Inquiry 652.

## BAR CODE

### Bar Code Readers

**For PC, XT, AT, PS/2, Macintosh and Serial Terminals**

- \* Attaches as 2nd Keyboard, no software changes
- \* Reads 2of5, 128, UPC/EAN, Code 39, etc.
- \* External or Internal attachment on PC
- \* Wand, CCD, Slot Badge, Magstripe or Laser
- \* Supports DOS, Novell, UNIX, Mac OS, etc.
- \* 100+ Configurable Options
- \* Supports USA & International Keyboards
- \* 2 Year Warranty, 30 Day \$ Back Guarantee
- \* Direct From Manufacturer
- \* **Top Rated by Independent Review**
- \* Complete with CCD Scanner - \$624
- \* Complete with Laser Scanner - \$784
- \* Complete Wand only Reader - \$329

### Worthington Data Solutions

3004 Mission Street • Santa Cruz, CA 95060 408-458-9938  
**800-345-4220**

### Labeling Software

For DOS and Windows with dot-matrix, LaserJet or DeskJet. Easy WYSIWYG design. Any format/size. Mix big text, bar codes, and PCX graphics. Formats for AIAG, KMart, Sears, MIL-STD, Penneys, WalMart. File Input. LabelRIGHT for DOS-\$279. LabelRIGHT for Windows-\$295.

30 Day Money Back Guarantee

### Worthington Data Solutions

(408) 458-9938 800-345-4220

## BAR CODE

### Portable Reader

- \* AA Battery Operated, 64K or 256K
- \* Display messages and optional voice messages tell operator what to do. Messages are easily recorded (like answering machine) in any language. This unit is EASY!
- \* Double duty as Non-portable Reader
- \* 4x20 Supertwist LCD Display, 35 Rubber Keys
- \* 2 Built-In Inventory Programs or create custom
- \* Download tables and Pick Lists
- \* Wand, CCD, or Laser Scanner Input
- \* Serial Interface and Keyboard Interface
- \* Reads 2of5, UPC/EAN, 128, Code 39, etc.
- \* 2 year Warranty on Reader & Wand
- \* 30 Day Money Back Guarantee
- \* 64K Complete with Steel Wand - \$799
- \* **Small Size and very long battery life**

### Worthington Data Solutions

3004 Mission Street • Santa Cruz, CA 95060  
**408-458-9938 FAX 408-458-9964 800-345-4220**

### RF Terminal

Communicates 2 way to Serial Base Station from 150-600 ft. Relay units extend range to 2400 ft. 1-16 terminals per base station. Keyboard, wand, CCD or laser scanner input. 16 Selectable frequencies. Small size and low weight - 12 oz. with batteries. Base Station - \$740  
Terminal - \$1096

### Worthington Data Solutions

(408) 458-9938 (800) 345-4220

### ADD IMPACT WITH

## COLOR IN THE BUYER'S MART!!

Attract the attention of your customers with the addition of color to your ad.

Call

**Ellen Perham**  
**603-924-2598**

or

**Mark Stone**  
**603-924-2695**

for details

**Fax 603-924-2683**

Inquiry 653.

## BAR CODE

### Windows Bar Code Fonts

Add bar codes to any font based Windows program. Fonts designed for dot matrix, DeskJet and LaserJet. Print Codabar, 2 of 5, Code 128, UPC/EAN and Code 39 inside your Windows program. TrueType fonts, bitmaps and metafile support included. Only \$199.

### Worthington Data Solutions

(408) 458-9938 (800) 345-4220

### Portable Bar Code Reader

- Use as a PORTABLE, WEDGE, or SERIAL
- 9V Battery Operation with Lithium Backup
- 2x16 Supertwist LCD Display
- 54 Key Keyboard with Separate Numeric Keys
- Real-time Clock Supports Date & Time Stamps
- Reads all Popular Bar Codes (16 types)
- Wand, CCD, Laser, or Serial Input Devices
- Built-In Program Generator
- Create Your Own Custom Programs
- 6 Built-In Inventory Programs
- Up to 250 Programs Can Reside in Memory
- Create up to 250 Data Files per Program
- Up to 250 Look-Up Files in Memory
- Built-In Calculator
- Supports HAYES Compatible Modems
- 64K Memory with Data Compression
- 30-day \$\$ Back Guarantee - 1 Year Warranty
- Complete Unit with WAND Scanner - \$795

### AMERICAN MICROSYSTEMS

2190 Regal Parkway, Euless, TX 76040  
**(800) 648-4452 (817) 571-9015 FAX (817) 685-6232**

### BAR CODE READERS

**For PC, XT, AT, PS/2, & Serial Terminals**

- Emulates Keyboard: Works With Any Software
- Data Appears as Keyboard Input
- Uses Enhanced Decoding Algorithms
- Accepts Wand, Slot/Badge, CCD, Laser, Magnetic Stripe Reader, & RS232 Serial Input
- Reads All Popular Bar Codes (16 types)
- Reads HIGH, MEDIUM, & LOW density codes
- Auto-Discriminates Between Bar Code Types
- Easily Programmed with a Bar Code Menu
- Over 140 User Configurable Options
- Daisy Chain Up to 96 Readers
- Supports NOVELL Networks
- Supports US & INTERNATIONAL Keyboards
- Direct From Manufacturer
- 30-day \$\$ Back Guarantee, 1 Year Warranty
- Complete Unit with LASER Scanner - \$645
- Complete Unit with WAND Scanner - \$299

### AMERICAN MICROSYSTEMS

2190 Regal Parkway, Euless, TX 76040  
**(800) 648-4452 (817) 571-9015 FAX (817) 685-6232**



# THE BUYER'S MART

## BAR CODE

### Bar Code Printing Software LabelWorks for Windows

- Prints all Popular Bar Code Types (19 Types)
- Desktop Publishing Features: WYSIWYG, Scalable Fonts, Rulers, Guides, Lines, Shapes, Page Zooms (25%-400%), Templates
- Rotates Text, Bar Codes, and Graphics
- Supports Windows Compatible Fonts
- Choose From Over One Hundred Popular Label Formats or Design Your Own
- Rich Text Support: Mix Styles, Types, & Sizes
- Automatically Prints Serial Numbers
- Imports & Exports Graphic Files: TIFF, GIF, BMP, PCX, WPG, WMF, TARGA
- Supports Virtually all Windows Compatible Printers (PostScript, Laser, & Dot Matrix)
- 30-day Money-Back Guarantee, \$295

\*\*\* CALL FOR FREE DEMO SOFTWARE \*\*\*

### AMERICAN MICROSYSTEMS

2190 Regal Parkway, Euless, TX 76040  
(800) 648-4452 (817) 571-9015 FAX (817) 685-6232

## BARCODE & MAG. STRIPE SYSTEMS

- **Keyboard Wedge with HP**  
Stainless Steel Wand/Mag. Stripe Reader **\$249**
- **Keyboard Wedge with SYMBOL LS2000**  
or SP400 Laser & Mag. Stripe Reader **\$849**
- **Keyboard Wedge with PSC QuickScan**  
Laser/Mag. Stripe Reader **\$699**
- **Software Wedge Decoder with HP Stainless Steel**  
Wand or Laser Scanner (DOS & WIN - RS-232 or parallel) **\$189 +**
- All **Wedge Packages** include a Wand or Laser Holder
- **Mag. Stripe Encoder/Reader (3 Trks)**  
w/Software **\$1299**
- **Printing Software (DOS, WIN, UNIX...)** **\$149 +**
- **Portable Data Terminals (128K-4.2MB)** **\$599 +**
- **Complete POS System: 486 40MHz** **\$1999**  
4MB RAM, monitor, POS Software, SP212 Receipt Printer,  
M-S Cash Drawer, pole display, HP stainless steel wand  
and magnetic stripe reader with decoder
- **Application Software:** Inven, Asset, Tools, Time & Attend...
- **Radio Frequency Terminals** (spread spectrum/narrow band)
- Bar Code Printing Software (DOS) included with each purchase
- Made in the USA • 30 Day \$% Back • Spanish Dept. Avail. • Direct from Mfg.

### BARCODE INTERNATIONAL SYSTEMS (BIS)

12140 Severn Way, Riverside, CA 92503 (909) 270-0016 Int'l  
(800) 653-4252 US • (800) 219-5178 CAN • FAX (909) 270-0920

Inquiry 654.

## CAD

**Circuit Design Software for Windows**  
Easy-to-use schematic entry, PCB design, and simulation software, starting at \$149 each. Complete PCB package with schematics, autorouter, and layout for 2-layer circuit boards, \$399. Enhanced version with autoplacement, more symbol libraries, and up to 16 layers, \$649. CAM file outputs.

### Mental Automation, Inc.

5415 136th Place, SE-Bellevue WA 98006  
(206) 641-2141 FAX (206) 649-0767 BBS (206) 641-2846

Inquiry 655.

## CAD/CAM

### CONTOURING MOTION CONTROL FROM A PRINTER PORT!

Indexer LPT™ software

**\$249**

VERSION 3

VISA/MC

- Controls up to six step motors simultaneously.
- Linear and Circular Interpolation.
- New features to accommodate machine control.
- Easy-to-use DOS device driver. Super Manual.
- CAD-CAM interface available.

### Ability Systems

Corporation, 1422 Arnold Ave.  
Roslyn, PA 19001 (215) 657-4338  
FAX: (215) 657-7815

Inquiry 656.

## CAD/CAM

### One-Step conversion of optical templates to NC!

Extremely simple & powerful this  
FastCOPY® DOS software is packaged with  
a 42"x60" GTCO Super LII digitizer  
& 16 button cursor for \$4,995

Call **FastCAM** at: (970) 667-5059

or FAX: (970) 667-1990

Ft. Collins, Colorado, U.S.A.

Inquiry 657.

## CD-ROM

### We Buy, Sell & Trade CD-ROMS & MEMORY CHIPS Resellers Wanted

Call or write for a free product update

### Consolidated CDROM, Inc.

515 67th Ave Philadelphia PA 19126 USA

+1-215-276-3657 / +1-215-276-3854 fax

**1-800-8-CDROMS**

Inquiry 658.

## INTERNET on CDROM!

GAMES for DAZE 2 CD Set .....\$30  
X2FTP Archive, hundreds of games & demos!

WORLD WIDE WEB Catalog on CD-ROM .....\$30  
See the Web without being on-line!

LINUX Developers Resource 4 CD Set .....\$25  
Complete OS, Source Code Slackware & more!

MOO-TIFF CD-ROM .....\$99  
Complete development sys, 100% OS/Motif

INTERNET Tools CD-ROM .....\$30  
Networking tools & utilities for DOS & UNIX

BSDisc (NetBSD & FreeBSD) .....\$35  
Ready to use formats with install scripts

USENET 2 CD Set .....\$25  
comp.sources & alt.sources & many FAQ's from other groups

SOURCE CODE CD-ROM .....\$30  
4.4 BSD-Lite, X11R6, MACH, Andrew Windowing

PERL & TCL/TK CD-ROM .....\$35  
Utility lang & command lang & toolkit for X-Windows

STANDARDS 2 CD Set .....\$30  
RFC's, IEN's, CCITT/ITU Bluebook, Windows Sockets

MC, VISA & AMEX **1-800-800-6613**

tel: +1-520-526-9565

### InfoMagic

fax: +1-520-526-9573

P.O. Box 30370, Flagstaff, AZ 86003-0370 info@infomagic.com

Inquiry 659.

## FREE CD-ROM

FREE CD-ROM with 600 MB from these PHT CDs:

- Visual Programming\* \$29.95 VisualBasic, C++, code, utils
- Internet PowerWEB\* \$29.95 HTML tools, docs, samples (+book)
- NTIA\* \$29.95 Windows NT apps, utils, docs
- WIA\* \$29.95 Great Windows apps, utils, docs
- Arcade Games\* \$29.95 Best DOS, Win games (+book)
- Blowfish OS/2\* \$29.95 Recent OS/2 apps, utils, docs
- Info-Mac\* \$49.95 Stanford University's Mac archive
- UMich\* \$29.95 Univ. of Michigan's Mac archive
- PIA\* \$29.95 Latest PowerMac apps, demos
- MacSource\* \$29.95 Mac code, utils, tools from Internet
- HyperStacks\* \$29.95 1000 HyperCard stacks
- Linux Developers Kit\* \$19.95 Latest Stackware, arc, docs
- Linux Run Time\* \$19.95 Ready-to-run Linux apps
- Linux Install Guide \$12.95 215 page book by Matt Welsh
- X11R6 \$29.95 X11 windowing system, src
- MPEGIA\* \$29.95 Cool MPEG movies, utils
- Space View \$29.95 650 MB images, docs on solar system
- Jupiter Impact \$29.95 S-L9 Comet collision: images, docs
- FontAsia TextPro \$29.95 Fonts, utils for Asian lgs (+book)
- ClipArt Palette \$29.95 1800 pieces great clipart (+book)
- PHT Illustrations \$39.95 100 color illustrations for DTP
- Paper CD Series \$39.95 Paper background images for DTP
- Bosworth Photos \$39.95 Royalty-free photos by N. Bosworth

**1-800-765-8369 T-Shirt offer, too!**

**PACIFIC HI-TECH** <http://www.pht.com/>

orders@pht.com / tel 801-261-1024 / fax 801-261-0310

\$5 US \$9 Int'l S/H applies to free CD and all orders

\*Shareware programs require separate payment to authors if found useful

Inquiry 660.

## CD-ROM

### CD ROM TOWERS & JUKEBOX SERVERS FOR ALL OPERATING SYSTEMS!

No Device Drivers/ MSCDEX needed,  
Complete Kit Networks CD Roms,  
unlimited user license, DISCPORT.

**"JES, NONE BETTER AT ANY PRICE"**

Call NOW: 1 (800) 482-1866 305-597-3980

Inquiry 661.

## New and Updated CDROM Titles

Cica MS Windows CDROM, Thsnds of Windows prgrms.....\$29.95  
Giga Games CDROM, Games for DOS/Windows.....\$39.95  
Space and Astronomy, Thsnds NASA images/data.....\$39.95  
C User Group Library, C source code Dec 93.....\$49.95  
Simtel MSDOS CDROM, DOS Shareware/Freeware.....\$29.95  
QRZ Ham Radio CDROM, FCC Callsign Db & Shrw.....\$29.95  
Hobbes OS/2 CDROM, OS/2 Shareware/Freeware.....\$29.95  
Source Code CDROM, 650 Mb source, DOS/Unix.....\$39.95  
Gutenberg Project, Literature and docs.....\$39.95  
Linux Operating Sys, 386/486 OS, X11, full src.....\$49.95  
FreeBSD Operating Sys, Ver 1.0, krl src, X/GNU.....\$39.95  
Libris Britannia, MSDOS Tech/Sci/Engineer.....\$69.95  
X11R5/Gnu CDROM, Full src, SPARC binaries.....\$39.95  
Nebula for NeXTSTEP, Prgrms for Intel NeXTSTEP.....\$39.95  
Ada Programming CDROM, Compilers, source, docs.....\$39.95  
Aminet CDROM, Amiga Shareware/Freeware.....\$29.95  
CDROM Caddies, Lifetime Guarantee.....\$4.95

Top quality CDROMs. 100% satisfied or full refund.

### WALNUT CREEK CDROM

4041 Pike Lane, Ste D-212, Concord, CA 94520

1-800-786-9907 Visa/MC AMEX, Fax: 1-510-674-0821

Inquiry 662.

## COMMUNICATIONS

### Frame Relay, X.25, BSC, HDLC, SDLC

Use our rock solid, compliant, inexpensive and robust  
synchronous products for your PC project. On board protocol  
support reduces PC overhead.

- Support for MS-DOS, Windows, Unix, OS/2, Netware and others.
- CCITT and ISO compliant X.25, HDLC.
- Frame Relay blanket certified for any application.
- Test and datascop programs for easy debugging.

### Sangoma Technologies Inc.

Tel 1-800-388-2475 905-474-1990

Fax 905-474-9223 E-Mail: dm@sangoma.com

## COMPUTER BOOKS

### COMPUTER BOOKS ONLINE

Easy online search & order at our CompuServe,  
Internet, & NIFTYServe stores. Books from 300  
publishers for computing professionals & users. GO  
CBK, [www.computobooks.com/books.html](http://www.computobooks.com/books.html), or ftp info.txt  
from ftp.computobooks.com. Worldwide shipping. E-mail  
to info@computobooks.com for info.

### Compubooks

RR1 Box 271D 512-321-9652

Cedar Creek TX 78612 USA Fax 512-321-4525

Order line 800-880-8818

## COMPUTER INSURANCE

### INSURES YOUR COMPUTER

SAFWARE Computerowner's coverage provides  
replacement of hardware, media and purchased  
software. As little as \$49 a year covers accidents,  
theft, power surges and more. One call does it all.

**1-800-800-1492**

**SAFWARE, The Insurance Agency Inc.**

PO Box 02211, 2929 N. High St., Columbus, OH 43202

Now available in Ontario!!!

Inquiry 663.



## COMPUTER MEMORY

### WE'LL PAY YOU FOR YOUR OLD MEMORY

Simms, Dips, Laser Printer, 1 Megx9, 4 Megx9, DRAM Chips

— ANY MEMORY —

All Memory Has Value! Don't let your old memory collect dust

Call or fax what you have available

**1-800-718-7755**  
**THE MEMORY LIQUIDATORS**

"The company that buys memory back"

531 Main St., Ste. 1174, El Segundo, CA 90245-3060  
Ph. 310-676-3074 Fax 310-676-3076

## COMPUTER TELEPHONY

### Write your own Telephony Applications

Create advanced, multi-line voice/fax systems with VOS, our multi-platform development language, or VoiceBox, our Visual Basic VBX. You can build any Computer Telephony application imaginable: Voice Mail, Fax-on-Demand, International Call-Back, Audiotex, Call Centers and many others.

Call for free booklet. Get into Call Processing with Parity Software

### Parity Software

US: 415-989-0330 Fax: 415-989-0330  
Europe: +45-3940.8803 Fax: +45-39.40.78.03

## DATA RECOVERY

### We Can Save It!

All Platforms - All Storage Devices  
Proprietary techniques so advanced we  
rescue data others simply abandon.

### DRIVESAVERS

Restoring data since 1985

**1-800-440-1904**

415-883-4232

Inquiry 664.

### The Leader in Data Recovery

- Expertise in virtually every operating system & media storage device.
- 24-Hour support & emergency services available.
- Call for a FREE consultation!

### ONTRACK DATA RECOVERY

MN: 1-800-872-2599 • CA: 1-800-752-7557  
DC: 1-800-650-2410 • Europe: +44 (0)181 974 5522

Inquiry 665.

## DATA/DISK CONVERSION

### THE #1 CHOICE in disk & tape conversion

for many leading corporations, government agencies,  
law firms, and companies in every industry—world-wide.

Free test • Satisfaction guaranteed

### Graphics Unlimited Inc.

3000 Second St. North, Minneapolis, MN 55411  
(612) 588-7571 FAX: (612) 588-8783  
1-800-745-7571

Inquiry 666.

## CONVERSION SERVICES

Convert any 9-track magnetic tape to or from  
over 6000 formats including 3 1/2", 5 1/4", 8" disk  
formats & word processors. Disk-to-disk con-  
versions also available. Introducing CD-ROM  
conversions. Call for more info.

### Pivar Computing Services, Inc.

165 Arlington Hgts. Rd., Dept. #B, Buffalo Grove, IL 60089  
(800) Convert (708) 459-6010

## DATA/DISK CONVERSION

### WE WROTE THE BOOK!

Deal direct with the company who developed the  
systems that most others use...  
**SHAFSTALL!** Tape/Diskette  
Transfer/Conversion/Duplication. PC/Mini/  
Mainframe/Workstation Tape Transfer. WP to  
WP Document Conversion Services.

**1-800-357-6250**

Shaffstall Corporation

317-842-2077

(Fax) 317-842-8294

Inquiry 667.

## EDUCATION

### B.S. & M.S. in COMPUTER SCIENCE

The American Institute For Computer Sciences offers an in-  
depth home study program to earn your Bachelor of Science  
at home. B.S. subjects covered are: MS/DOS, BASIC,  
PASCAL, C, C++, Data File Processing, Data Structures &  
Operating Systems. M.S. program includes subjects in  
Software Engineering and Artificial Intelligence. Ada and  
Using Windows courses also available. Accredited Member:  
World Association of Universities and Colleges.

### AMERICAN INST. for COMPUTER SCIENCES

2101-BY Magnolia Ave., Suite 200, Birmingham, AL 35205

**1-800-767-2427 • 1-205-323-6191**

## ELECTRONIC DICTIONARIES

### BILINGUAL DICTIONARIES FOR DOS & WINDOWS

French, German, Spanish & Italian  
AMEX, Access, Visa, MasterCard, EuroCard, VISA

### HarperCollins

Electronic Reference

Tel +44 (0)1903 873 555 Fax +44 (0)1903 873 633  
E-mail 100317.1372@compuserve.com

Inquiry 668.

## FLOPPY DISKETTE

### 3.5" FLOPPY DISK RELIABLE & DURABLE

- We are a manufacturer licensed by Sony Corporation.
- Our disks are all 100% Tested and Certified Error Free with guaranteed Clipping Level.
- Available products: 2HD, 2DD, video tape, CD jewelery box.
- Our own brand MEGA, OEM or bulk pack are also available.
- Duplicators & wholesalers are welcome.

### YHC Cassette Ind. Ltd.

75 Saintsbury Square  
Scarborough, Ont.  
M1V 3K1 Canada  
Tel: (416) 321-1179  
Fax: (416) 321-8451

### INMARK IND. LTD.

1A Man Fong Industrial Bldg.  
7 Cheung Lee Street,  
Chai Wan, Hong Kong  
Tel: (852) 5582203  
Fax: (852) 8973700

Inquiry 669.

## FLOW CHARTS

### COBOL STRUCTURE CHARTS

The new PowerStructure for Windows generates  
incredible structure charts DIRECTLY from your  
COBOL source — STRUCTURED or NOT! Forget  
manual flowcharting. PowerStructure will diagram  
your spaghetti code, do it in seconds, and free  
programmers for more important work.  
Now just \$149.

### CyberMetrics

5541 S. Marine Drive., Tempe, AZ 85283  
(602) 838-3310

Inquiry 670.

## WINDOWS FLOWCHARTER \$129

RFFlow 3.0 is a professional drawing tool for  
flowcharts & org. charts. Requires Microsoft Win-  
dows; 500 shapes auto adjust in size; diagonal lines  
and curves; auto line routing and re-routing; OLE  
server; click on a shape to bring up a sub-chart;  
import/export bitmaps and metafiles; Call for free  
trial disk.

### RFF ELECTRONICS

1053 Banyan Court, Loveland, CO 80538

Phone: (970) 663-5767

FAX: (970) 669-4889

## FOREIGN LANGUAGES

### OVER 150 LANGUAGES

Translation, Language Learning  
Tutorials, Fonts, Dictionaries and  
Language Systems for DOS, Mac and Windows.  
Japanese, Chinese, Spanish speaking staff.  
Call us first for best prices and expert support.

### Character Language Resources

2130 Sawtelle Blvd. 304A, Los Angeles, CA 90025  
800-569-2099 FAX 310-996-2303

Inquiry 671.

## FORMS DESIGN & PRINTING

### PCL FORMS OVERLAY MACROS...

Forms Electric is the forms overlay solution for  
LaserJet & compatible printers. Use your preferred  
Windows applications to create PCL forms overlay  
macros for merging with Windows, DOS, UNIX and  
AS/400 applications. Windows 95 supported.

...From US \$95.00 / UK £59.95

### Visual Software

Telephone & Fax: +44 1306 742 425

CIS: 100023, 1167 E-mail: geddes@atlas.co.uk

Inquiry 672.

## FORTRAN

### LS FORTRAN for Power Macintosh

- ★ ANSI standard FORTRAN 77 compiler
- ★ Built-in diagnostics and source level debugging
- ★ Mainframe extensions (VAX, Data General, Cray)
- ★ Optimized code generation for any Macintosh
- ★ Up to 29 mflops (SLInpack)

### Language Systems Corporation

(800) 252-6479

(703) 689-9593 Fax

100 Carpenter Dr.

Sterling, VA 20164

Inquiry 673.

## HARDWARE

### Pre-Owned Electronics, Inc.™

THE Independent Provider, serving the Dealer,  
Professional, Corporate, Government, and  
Educational Buyer since 1985.

### APPLE II® & MACINTOSH® SYSTEMS • PARTS • EXCHANGE REPAIRS

Call for a Catalog... **800-274-5343**  
INT'L: 617-275-4600 • FAX: 617-275-4848

205 BURLINGTON ROAD • BEDFORD, MA 01730

Inquiry 674.

## HEWLETT-PACKARD

Buy - Sell - Trade

LaserJet ColorPro  
DeskJet DraftPro  
RuggedWriter DraftMaster  
Electrostatic Plotters DesignJet

HP 9000 Workstations and Vectras also available.

### Ted Dasher & Associates

4117 Second Ave., S. Birmingham, AL 35222

Phone: (205) 591-4747 Fax: (205) 591-1108

(800) 638-4833

E-mail: sales@dasher.com

Inquiry 675.

## LANS

### Little Big LAN

The most flexible network

- Peer to Peer LAN to 250 nodes
- \$75 total software cost, not per node!
- Link via serial, parallel, or Modems
- Also via Ethernet or Arcnet, or mix!
- Typically only 40k of RAM

### Information Modes

817-387-3339 / P.O. Drawer F, Denton TX 76202

Fax 817-382-7407

Orders 800-628-7992

Inquiry 676.



# THE BUYER'S MART

## LASER CHECKS

### LASER CHECKS

PERSONALIZED WITH YOUR NAME AND LOGO  
IN SAFETY BACKGROUND  
CALL (714) 773-5811 OR TOLL FREE  
1-800-252-6427 Fax 1-800-439-0158  
FOR SAMPLE (ETC.)  
:MAGNETIC ENCODING:  
MICR-COMP, Inc.  
689 S. State College Blvd., Suite A  
Fullerton, CA 92631

Inquiry 677.

## MANUFACTURING SOFTWARE

### Manufacturing Software

E-Z-MRP™ is complete material requirements planning software for the PC. Includes bill of materials, material planning make/buy calculation, capacity planning, purchase orders, labor distribution, job costing, physical inventory, AutoCAD interface, and more. The best entry-level manufacturing solution. Complete for \$2,995. Special Lite version for \$995. Call for information.

**Alliance Manufacturing Software**  
1-800-490-2520

## PC DATA SECURITY

### Secure Your Data

Today more and more sensitive information is being stored on computer. PCs are notoriously insecure. Laptops are continually being lost or stolen.  
DEADLOCK is a software-only data protection system for IBM compatible PCs which, when installed, creates a separate lockable data storage area on your hard disk. This area is accessed like any normal drive and all information stored in it is automatically encrypted. Only \$39 + VAT (\$149).

### Security Intelligence

Collier House, 163-169 Brompton Road, London, SW3 1PY  
England +44 171 589 4567 (Tel), +44 171 584 4824 (Fax).

Inquiry 678.

## PROGRAMMERS TOOLS

### The Fastest xBASE Engine

CodeBase provides C, C++, Visual Basic and Delphi programmers with the *fastest* xBASE compatible database engine. Get multi-user compatibility with FoxPro, Clipper and dBASE files. And it's *portable* from DOS to Windows to UNIX!

FREE 30 day trial

Call **Sequiter Software Inc.** for details!  
Phone 403-437-2410 FAX 403-436-2999

Inquiry 679.

## SECURITY

### Leaders in Software Security

EVERLOCK and EVERKEY II copy protection. Features include - Encryption, Serialization, Remotely resettable access flags, date limits, execution counts and network user limits - and much more! Free demo available.

Call today and ask about our low cost Trial Kits!

**Az-Tech Software, Inc.**  
201 East Franklin St., Richmond, MO 64085-1883  
(800) 227-0644 (816) 776-2700 FAX (816) 776-8398

Inquiry 680.

## THE ULTIMATE SOFTWARE SECURITY

- STOPCOPY family - UNCOPIABLE copy protection
- STOPVIEW software encryption
- NETLIMIT network license metering
- DOS, Windows, Macintosh, OS/2, support
- No source code changes required - for ANY of our products in ANY environment
- Our products destroy ALL of our competition
- Call for FREE demo disk, or to discuss our products' MANY options

**BBi Computer Systems, Inc.**  
14105 Heritage Lane, Silver Spring, MD 20906  
800/TRY-ABBI • 800/879-2224 • 301/871-1094 • FAX:301/460-7545

Inquiry 681.

## SECURITY

### CRYPKEY SOFTWARE LICENSING SYSTEM

\*Software Copy Protection with NO Hardware Key and NO Disk Key\*

- CrypKey is **software copy protection** that is
- completely secure from any disk copy program
  - completely compatible with MSDOS, MS WINDOWS, WIN 95, WIN NT
  - completely compatible with CD-ROM, BBS, or Internet distribution!
  - customer friendly - no disk key, no hardware key, less support calls

CrypKey can **increase your software sales** by allowing you to sell your program

- by increments - sell add-on software options or levels to your customers
- by number of runs - e.g. sell 100 calculations for \$100.00
- by time period - e.g. lease or demo your program for 60 days

CrypKey uses a numeric key that can be transmitted by phone, fax, or email. Sell your customers more options, more copies, more time or more runs instantly, just by making a telephone call (great for overseas customers or distributors). CrypKey is produced by Kenonic Controls Ltd. - engineering and software since 1972.

**Kenonic Controls Limited**  
7175-12th Street South East  
Calgary, Alberta, Canada T2H 2S6  
(403) 258-6200 • fax: (403) 258-6201  
INTERNET: crypkey@kenonic.com

Inquiry 682.

### Cop's CopyLock II

Professional software protection with TRUE Machine Install. Option Board safe. DOS, OS2, Networks, Windows, Trace 3000. DialCOPS Access Control for mass distribution via CD-ROM or Internet. Known and used world-wide since 1984.

### LINK Data Security

Int'l: + 45 3123-2350 Fax: + 45 3123-8448

## KEY-LOK™ SECURITY

Piracy survival 11 years proves effectiveness of powerful multilayered security. Algorithmic response. Programmable memory. Economical. Transparent to PARALLEL/SERIAL port, Counters/Real-Time-Clock. Multi-product/feature licensing. DOS/NT/UNIX/OS2. Access control systems and disk drive locks.

### MICROCOMPUTER APPLICATIONS

3167 E. Otero Circle, Littleton, CO 80122  
1-800-4KEYLOK (303) 770-1917 FAX: (303) 770-1863

Inquiry 683.

## SOFTWARE PACKAGING

### FREE SOFTWARE PACKAGING CATALOG

Everything you will need to Package, Distribute, and Ship Your Software! From manuals and binders to mailers and shippers

### LABELS • LABELS • LABELS

For your diskettes, plain or custom printed dot matrix or laser printer... free samples

### ...FREE CATALOG...

### Hice & Associates

8586 Monticello Dr., West Chester, OH 45069  
Phone/Fax: 513-779-7977

Inquiry 684.

## SOFTWARE/BUSINESS

### DATA ENTRY SOFTWARE

Full featured, heads-down data entry with two-pass verification, edit language, operator stats, batch control, on-line help, output record reformat, free tech support.

For the PC, PC LAN, S/36, AS/400.

FREE 30 day trial

**Computer Keyes**  
21929 Makah Rd.,  
Woodway, WA 98020  
Tel: 206-776-6443  
Fax: 206-776-7210  
USA: 800-356-0203

## SOFTWARE/ENGINEERING

### Circuit Simulation New LOW COST SPICE Tools

#### Introducing ICAP/4Lite

### Affordable SPICE

Experience Analog and Mixed signal simulation like you've never seen before  
*"Just like being at the Bench."*

includes:

- New IsSpice4; Real Time Interactive Display
- UNLIMITED Circuit Size!
- Integrated Schematic Editor
- Model Libraries, more than 500 Parts
- Windows, Windows NT

Full SPICE programs starting at \$95. Complete systems with schematic entry, IsSpice4, models, and waveform graphics only \$595.

Call or Fax for your Free Demo kit

P.O. Box 710, San Pedro, Ca 90733-0710

Tel (310) 833-0710

FAX (310) 833-9658 **intusoft**

Inquiry 685.

## FIT DATA EFFORTLESSLY!

**Magestic™** - Outstanding, flexible fitting from within MS Excel. Handles large models, multiple functions simultaneously, arbitrary numbers of parameters, numerical or user-supplied derivatives, automatic sequences. Plus Monte Carlo global minimization, DLL interface for huge/complex models. \$295

**Logix Con. Inc. 1-800-900-5541**

Check us on the web: <http://www.lgix.com>

Inquiry 686.

## EXPERIMENTAL DATA FITTING

SCIENTIST™ is the leader in experimental data fitting. Fit combinations of user-defined algebraic and differential equations or Laplace transforms - also splines and interpolating functions. Includes 3D plotting and a scientific worksheet. Requires Windows. \$395. Model libraries also available.

### MicroMath Scientific Software

1-800-942-6284 Fax: (801) 943-0299

Inquiry 687.

## SOFTWARE/GRAPHICS

### New Version!

### AccuSoft Image Format Library 5.0

**Programmers: Add support for 36 raster file formats instantly!**

TIFF, JPEG, PCX, TARGA, DIB, DCX, GIF, BMP, WMF, PICT, WPG, EPS, Group 3, Group 4  
**New Formats:** Photo CD, PhotoShop, ASCII, KoFax, RLE, LaserData, CALS, ATT, CLP, XWD, IMG, IFF, SUN, XBM, ICO, IOCA, CX2, XPM, CUT, Brooktrout, MAC, MSP.

*Guaranteed to read all raster images in existence in the listed formats!*

- \* Import, export, scanning, conversion, compression
- \* Printing, display, image processing
- \* Supports all languages
- \* Fax formats and multi-page images
- \* Rotate, zoom, scale, color reduction
- \* Thumbnails, sharpen, special-effects
- \* Windows, NT, WinPro Gold 32, VBX, VBX32
- \* Watcom, OS/2, MAC, UNIX, Clipper, FoxPro

**AccuSoft Corp. Call 800-525-3577**

Two Westborough Business Park Westborough, MA 01581 USA

TEL (508) 898-2770 FAX (508) 898-9662

Inquiry 688.



## SOFTWARE/ENGINEERING

### SAUNA: 3D THERMAL ANALYSIS

- Models: PCBs, stacked plates, heatsinks, multiboard enclosures.
- All heat transfer modes: convection, radiation, conduction
- Interactive menu-driven
- Thermal parameters library
- Fast "What if": dimension, mat'l, finish, analyses
- Easy to learn & use
- IBM PC & Macintosh II

Call or FAX for free evaluation program

#### Tatum Labs, Inc.

1287 N. Silo Ridge Drive, Ann Arbor, MI 48108

313-663-8810

FAX 313-663-3640

Inquiry 689.

## SOFTWARE/GRAPHICS

### Autodesk's DWG OEM

- Programmers' Toolkit to Read/Write AutoCAD DWG & DXF Files.
- Object oriented, modular, database-like access to CAD data.
- View, Print, Plot and Pick Modules.
- Available for C/C++ for DOS, X-DOS, Windows, Sun, and other Unix systems.

#### Autodesk OEM Sales

1301 Marina Village Parkway, Alameda, CA 94501

Phone: (510) 337-7203 Fax: (510) 523-2880

Inquiry 690.

### DbCAD dev 1.3 DLLs

Create, select, edit, import (DXF, DWG), all the AutoCAD 2D vector entities, in a graphics database (DBF). Display raster images (RLC, RLE, BMP) on which you can overlay vector drawings (DWG, WMF, graphic DBF). Manage a graphic window (pan, zoom, overview, pick). Print by using Windows driver and fonts.

#### Channel inc. U.S.A.

+617-863-0068

Inquiry 691.

### CAD Developers Kit

TC-CAD Professional 5.5, a 'C' Win/DOS SDK. Read/Write/View PCX/GIF files & DXF to R12. Create fonts & text. Ray Tracing & Shading. Hundreds of 2D & 3D routines. Comes as DOS Lib., Win Lib. & Win DLL. Source available. Free Technical White Paper available. Call or write today.

Disk Software, Inc., Box 941152

Plano, TX USA 75094-1152

800-635-7760, Fax 214-423-7288

Inquiry 692.

### "LEADTOOLS does image manipulation and does it right!"

BYTE Magazine, 2/95

Discover what Kodak, Corel, Delrina and over 2500 developers, publishers and OEMs already know: LEAD offers the fastest and most complete image compression and manipulation SDK on the market.

#### Three Toolkits In One!

Introducing LEADTOOLS version 5, offering three toolkits for the price of one: 1) image format support, conversion and compression, 2) image processing and, 3) all NEW BITONAL toolkit. Includes royalty-free runtime, virtual memory management for unlimited image size, free technical support, online help, sample programs with source code, over 40 image processing functions, and CMP, the virtually lossless image compression format.

Call today for FREE imaging application built with LEADTOOLS 5!

**800-637-1835**



**LEAD  
TECHNOLOGIES  
INCORPORATED**

900 Baxter Street • Charlotte, NC 28204 • 704-332-5532 Fax: 704-372-8161

Inquiry 693.

## SOFTWARE/SCIENTIFIC

### VTX Scientific Desktop Publishing

- Scalable Fonts • Font effects • Typeface customization
- Equations • Tables • Graphics • Foreign languages
- Multi-lingual spell & hyphenation • IDE • On-line help
- Dos, Dos-32 and Windows versions • From \$199

"TeX of Tomorrow" - Notices of AMS, March 1991

Call now for a **FREE DEMO DISK**

#### MicroPress, Inc.

68-30 Harrow Street, Forest Hills, NY 11375

Tel (718) 575-1816

Fax (718) 575-8038

Inquiry 694.

## SOFTWARE/VOICE/FAX

### Computer Telephony 'C' Libraries

Multi-Voice V4.0 and Multi-Fax V2.0 Toolkits give you the most powerful solution to integrate telephony to your 'C' applications. Unique design based on multi-tasking: DOS Extender; Supports most major voice and fax boards; Commented source code; Royalty free; Best value. Also available: Windows based application generator.

#### ITI SOFTWARE

Tel: 514-835-3124 Fax: 514-835-4772 BBS: 514-835-5945

Fax-On-Demand: 514-835-2216, E-mail: ggaggon@cam.org

Check our home page: <http://www.cam.org/~ggaggon>

## UNIX FOR PCS

### LINUX

RELEASE 1.1

32 bit Unix compatible OS for 386, 486, 586's

Includes C, C++, Obj. C, Pascal, smalltalk, Perl, X11 R6, TCP/IP, UUCP, PPP, Slip, NFS, VI, emacs, Openlook, plus much more. Supports: SCSI, IDE, ESDI, MFM, VGA, S3, CGA, CD-Rom, Soundblaster, full man pages, 600 pg. manual included. "Full Internet support" \$59.95 on CD-ROM, \$69.95 on disks, Dr. Linus Book \$49.95.

Linux Systems Labs, 49884 Miller Ct. Chesterfield, MI 48047  
(800) 954-2938, (810) 716-1700, fax (810) 716-1703

Inquiry 695.

## VAX TO PC TRANSLATION

### Vax Basic to Visual Basic

Multiple passes of your code plus over 300 tests on every Vax line. Up to 100% translation. Step by step example. RMS solution. Model for forms building. Vax \$1500-3000 plus per PC license.

#### Mikado Computing Ltd.

309 Regent St., London W1R 8AL, UK

• Call +44 171 323 5423 (24hrs messaging)

• Fax +44 171 911 5104

• e-mail 100114.1110@Compuserve.com

Inquiry 696.

## WEATHER SATELLITES

### Weather reception with Laptop or PC using PCMCIA satellite decoder and software

View cloud formations, watch storms develop, measure sea surface temperatures and plot course using range/bearing tools from NOAA polar orbiting weather satellite images captured live on your laptop computer! G.P.S. interface.

Also captures geostationary satellites and HF Marine Fax. Portable system used by mariners, aviators, computer hobbyists and professionals. Complete systems available including:

• PCMCIA type II card/software and VHF receiver/antenna.

• OFS WeatherFAX, 6404 Lakerest Court, Raleigh, NC 27612  
Phone/fax: (919) 847-4545, EMail: jdahl@cybernetics.net

## WINDOWS

### \* FREE INTERNET

**217-322-1111**

Full Access 14.4K 8/N/1 All Nodes  
Service is FREE \*You Pay L.D. Charge

Voice Help 1-217-322-1212

Inquiry 697.

## WINDOWS

### THE ULTIMATE BBS

**FREE FREE FREE FREE FREE FREE**

Latest Windows and DOS Utils, Pgms, Source Code, Lively CHAT, online games, Internet Access and more and all FREE. Call from home or office up to 14.4K and download for FREE. (n/8/1)

**217-792-3663**

Customer Service 415-281-4429

Inquiry 698.

## There Are 275,000 Good Reasons to Advertise in the BYTE Deck!

The BYTE Deck mails to a select group of **275,000 BYTE subscribers** who are proven direct market buyers.

In fact, BYTE subscriber surveys show that many readers prefer to buy through the mail order/direct channel:

### Direct Channel Preference for Purchases of:

Software 69%

Computer Systems 63%

Peripherals 62%

Networking 45%

Source: 1994 Subscriber Study

The average BYTE reader influences the purchase decisions of **107 others**, works in a company with more than **1,000 employees**, and influences **more computer product purchases** than any other person in his/her organization. The BYTE readership provides quality leads. **Why settle for anything less?**

**Call Brian Higgins today at (603) 924-2596 or fax your order to (603) 924-2683.**

**The BYTE Reader:  
Simply the Best**

**BYTE DECK**





# ADVERTISER CONTACT INFORMATION

To order products or request FREE information, call advertisers directly or send in the response card by mail or fax! Let them know you saw it in **BYTE!**

Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.
<b>A</b>						<b>L</b>		
194-195	ACI	316 800-983-1177	*	DATA ACCESS CORP	192 800-451-3539	179-180	KUREO TECHNOLOGY INC	318 604-433-7715
132	ACTION	308 +886-3-4520697**	291	DATA COMMUNICATIONS (INT'L)	225	310-311	L A TRADE	170 800-433-3726
176-177	ADVANCED IMAGE COMMUNICATIONS	313 510-947-1000	220-221	DATALUX CORP	169 800-DATALUX	143	LAHEY COMPUTER SYSTEMS	318 800-548-4778
*	ADVANCED MICRO DEVICES (N.A.)	106-107 800-222-9323	*	DATAPRODUCTS	153 818-887-8000	565-566	LANNET DATA COMMUNICATIONS (INT'L)	227 +972-3-645-8458
264-265	AERONICS INC	141 512-258-8040	*	DELL COMPUTER CORP (N.A.)	CIII 800-247-5508	144	LAWSON LABS INC	312 800-444-5355
303-304	AGE LOGIC	174 619-755-1000	*	DELL COMPUTER CORP (N.A.)	CIV 800-247-2304	549-550	LOCUS COMPUTING (INT'L)	69 locus@uklotus.com
214-215	ALADDIN KNOWLEDGE SYS (INT'L)	50-52 212-564-5678	*	DELL COMPUTER CORP (N.A.)	32NA 3 800-247-5519	520	LOGIC PROGRAMMING ASSOC	32IS 22 800-949-7567
214-215	ALADDIN KNOWLEDGE SYS (U.S.)	50-52 800-223-4277	*	DELL COMPUTER CORP (N.A., F1000)	32NA 5 800-247-5524	551-552	LUNAR ENERGY CO	32IS 24 817-387-MOON
102	ALLMICRO	218 800-653-4933	*	DELL COMPUTER CORP (N.A., F1000)	CIII 800-283-1410	210	LYBEN COMPUTER SYSTEMS	309 800-493-5777
284	ALTEX ELECTRONICS	188 800-531-5369	340	DELIRIA WIN FAX PRO	78 800-268-6082	<b>M</b>		
136	AMERICAN ADVANTECH	312 800-800-6889	222-223	DELTEC / NSSI	158 800-335-8321	314	MACON	187 +49-7254-983-290**
*	AMERICAN POWER CONVERSION	8A-B 401-788-2797**	316	DESIGNER CHECKS	193 800-239-4087	536	MANNESMANN TALLY	32IS 21 +44 (0) 1734 788711
344	AMERICAN POWER CONVERSION	8-9 800-800-4APC dept A2	355-356	DIALOGIC / STYLUS (INT'L)	210 +32(2) 725 08 90	261	MARX INTERNATIONAL	162 800-MARX-INT
285-286	AMERICAN SMALL BUSINESS COMPUTERS	178 800-233-3223	353-354	DIALOGIC / STYLUS (N.A.)	210 617-621-9545	278-279	MAXTECH CORP (N.A.)	103 201-579-3630
205	ANALOG WAY	315 +33-1-60-11-17-64**	65-66	DIGI INTERNATIONAL	207 800-551-4797	*	MCGRW HILL NRI (N.A.)	214A-B
133-134	ANGLE TECHNOLOGY INC	303 800-858-2173	560-561	DIGICOM (INT'L)	62-63 +886 2 917 9099**	*	MCGRW-HILL COMPANIES (INT'L)	106
202	ANTEC	314 510-770-1200 ext 313	540-541	DISTINCT CORP	32IS 16 408-366-8933	282	MIDI SYSTEMS LTD	90 +44(0)1368 850678
*	ANTHRO CORP	208 800-325-3841	67	DISTRIBUTED PROCESSING TECH	257 407-830-5522	107	MEGAHERTZ CORP (N.A.)	32NA 1 800-LINKING ext 4316
*	APPLE COMPUTER INC	111 www.apple.com	526-527	ECEL (INT'L)	103 +886-2-772-3407**	554	MESSE MUENCHEN GMBH (SYSTEMS 95)	32IS 23 +49-89-5107-506
*	APPLE COMPUTER INC	113 www.apple.com	528-529	ECEL (INT'L)	105 +886-2-772-3407**	301	MICRO 2000	190 800-864-8008
*	APPLE COMPUTER INC (U.S.)	32A-H www.apple.com	162	EDUCALC	314 800-713-6525	302	MICRO 2000	191 800-864-8008
135	ASHTK INC	295 800-801-9400	567-568	ELEKTROSON BV (INT'L)	217 +31-40-51-50-65	294-295	MICRO SOLUTIONS COMP PROD	179 800-295-1214
271	AT&T GLOBAL INFO SOLUTIONS (N.A.)	56-57 800-447-1124 ext 1117	508-509	ELASHIM MICROCOMPUTERS	32IS 4 210 617-621-9545	227-228	MICROGRAFX	161 800-877-3040
534-535	AXIS COMMUNICATIONS (INT'L)	127 +46 46 140500	174-175	ELMA ELECTRONIC	313 510-656-3400	305	MICRO-INTERNATIONAL INC	175 800-967-5667
<b>B</b>			557-558	ELPROMA ELECTRONICA BV	32IS 18 +31-3438-12286	96	MICRON COMPUTER	CIII 1 208-465-3434
312	BADGER COMPUTER	197 800-3-BADGER	317	EMATEX GMBH	189 +49 221 529666	341-342	MICROPOLIS CORP (NAM)	164 800-395-3748
111	BBN SOFTWARE PRODUCTS (N.A.)	225 800-331-2266 ext 130	538-539	ERGOTRON EUROPE	32IS 13 +31 20 696.60.65	*	MICROSOFT CORP	2-3 800-871-3271 ext AV3
*	BEAME & WHITESIDE S/W	32IS 6 919-831-8989	545-546	EUROSOFT TECHNOLOGY	32IS 19 +44 1635 582 660	*	MICROSOFT CORP	12-13 800-871-3271 ext AV3
531-532	BEAME & WHITESIDE S/W	32IS 7 919-831-8989	510	EUTRON	32IS 20 +39 35 201003	*	MICROSTAR LABORATORIES	313 206-453-2345
96-97	BEAME & WHITESIDE S/W (N.A.)	227 800-216-8450	68-69	EXABYTE CORP	19 800-EXABYTE	*	MICROWAY	204 508-746-7341
216-217	BELL & HOWELL INC (INT'L)	130 708-675-7600	511-512	FAST HARDLOCK	32IS 9 +49-89-539800-20	193	MICRO / SYS	315 818-244-4600
216-217	BELL & HOWELL INC (N.A.)	130 800-SCAN-494	105	FINSON	237 +39-2-6698-7036	232-233	MINUTEMAN	104 214-446-7363
450	BIX	329 800-695-4775	525	FIRST INTERNATIONAL COMP	32IS 2 +886-2-718-2782**	325	MIPS DATALINE AMERICA INC	193 800-898-8560
501-502	BOCA RESEARCH INC (INT'L)	120 407-997-6227	124-125	FIRST SOURCE INT'L	294 714-448-7750	76	MKS / MORTICE KERN SYSTEMS	148 519-884-2251
185-186	BOXLIGHT CORP	316 800-762-5757	224	FRAME TECHNOLOGY (N.A.)	105 800-U4FRAME ext 640	229	MOTOROLA	115 800-894-7353
331-332	BURBOTICS	172 +41-22-779-1504**	70-71	FRONTIER TECHNOLOGIES	78 800-929-3054	*	MOTOROLA	134-135
*	BUSINESS WEEK (INT'L)	277	*	FUTURE MICRO INC	306 714-622-9137	*	MOTOROLA	136-137
*	BYTE BACK ISSUES (INT'L)	209	181	FUZZWARE INC	318 800-472-6183	116-117	MRT (INT'L)	241 +47-638-92020
*	BYTE EDITORIAL SURVEY	282	138	GAGE APPLIED SCIENCES INC	312 514-337-6893	116-117	MRT (U.S.)	241 603-465-2830
*	BYTE EURODECK (INT'L)	107	292-293	GALACTICOMM INC	177 305-583-5990	296	MUSTANG SOFTWARE	186 800-663-7509
*	BYTE MOBILE OFFICE SWEEPSTAKES (U.S.)	283	*	GATEWAY 2000	88-89 800-846-2058	<b>N</b>		
*	BYTE NETWORKING ON DISK	242	206-207	GLOBETEK	309 800-229-4640	230-231	NANAO USA CORP (N.A.)	81 310-325-5202
63	BYTE ON CD ROM	232 603-924-2625	160-161	GRANITE DIGITAL	313 510-471-6442	145	NATIONAL INSTRUMENTS	318 512-794-0100
*	BYTE READER	262 603-924-9281	513	GREY MATTER LTD (INT'L)	71 +44-(0)1364-53071	521-522	NATIONAL INSTRUMENTS	32IS 10 512-794-0100
*	BYTE REPRINTS	283 603-924-2525	<b>H</b>			*	NETWORLD+INTEROP 95 ATLANTA GA	285 800-488-2883
*	BYTE SUB MESSAGE	278	170	HALL RESEARCH & TECHNOLOGIES INC	309 800-959-6439	178	NEWICE	310 703-648-0585
*	BYTE WEARHOUSE	238 708-647-4902	*	HEWLETT PACKARD	61 800-85-1170 ext 9553	77	NINTENDO (N.A.)	62-63 www.nintendo.com
157	BYTECH BUSINESS SYSTEMS	318 914-354-8666	563	HITACHI (INT'L)	83	77	NOBLENET	222 508-460-3456**
<b>C</b>			191-192	HOEI SANGYO CO LTD	315 +81-3-3661-9147**	78	NSTL	266 610-941-9600
106	CALIFORNIA PC PRODUCTS INC	276 800-394-4122	139	HOLEON CORP	314 520-634-7515	<b>O</b>		
196-197	CAMELION TECHNOLOGY INC	314 800-440-7466	542	HYPERSYSTEMS	32IS 24 +39-11-434-2350	184	OBJECT MANAGEMENT LAB	318 800-6789-OML
559	CASPER	32IS 19 +45 67 67 3000	<b>I</b>			553	OBJECT WORLD (INT'L)	164 +49-6173-2852
*	CHEMPUTER (INT'L)	28-29 +49-69-71407-0	*	IBM APPLICATIONS DEVELOPMENT	34-35 800-IBM-3333 ext GA070	108	OBJECTS INC	228 508-777-2800
323-324	COMBYTE INC	166 303-229-0660	*	IBM DATA MANAGEMENT (N.A.)	28-29 800-IBM-3333 ext GA061	514-515	OLIVETTI S.P.A. (INT'L)	16-17 +39-125-52-48-13
547-548	COMBYTE INC (INT'L)	CIV 303-229-0660	*	IBM PC 700 (N.A.)	15-17 800 IBM 4 FAX #8463468	516-517	OLIVETTI S.P.A. (INT'L)	56-57 +39-2-48361
*	COMPAQ NOTEBOOKS (N.A.)	32NA 6-7 800-345-1518	*	IBM POWER SERIES (N.A.)	15-17 800 IBM 4 FAX #8473643	297-298	OMNICOPT GRAPHICS CORP	167 713-464-2990
503-504	COMPUTER INC (INT'L)	81 714-630-7302	*	IBM SERVERS (N.A.)	69 800-772-2227 ID#2509	530	ON TIME MARKETING	32IS 22 +49-40-437472
*	COMPUSEIVE (N.A.)	116A-B 800-487-4838	*	IBM SERVERS (N.A.)	71 800-772-2227 ID#3170	146-147	OPUS SYSTEMS	309 408-562-9340
218	COMPUSEIVE (INT'L)	117 614-529-1349	328-329	ICL (EMBLA)	166 703-648-3326**	130-131	ORCHESTRA MULTISYSTEMS	180 800-237-9988
218	COMPUSEIVE (N.A.)	117 800-487-4838	269-270	ICONOVEX INC (N.A.)	139 800-943-0292	*	OSBORNE MCGRW-HILL	246-247 800-822-8158
*	COMPUTER BOOK CLUB, THE	278A-B 614-759-3749**	564	INFOCUS (INT'L)	11 +31-2503-23200	164-165	OUTOKUMPU RESEARCH OY	317 +358-39-626-5067
*	COMPUTER BOOK CLUB, THE	279	182-183	INNOVENTION INDUSTRIES INC	312 416-636-0052	<b>P</b>		
118	COMPUTER DISCOUNT WAREHOUSE	292-293 800-959-4COW	283	INSTINCT SRL	155 +39-6-37-21-790	79	PANASONIC COMMUNICATIONS & SYSTEMS	253 800-742-8086 ext PD
203-204	COMPUTER GATE	309 408-730-0673	140	INTERGRAND RESEARCH	311 209-651-1203	212	PANELIGHT	316 800-726-3599
*	COMPUTER PURCHASER'S HELP LINE	182 900-976-8723	516-519	INTERGRAPH CORP (INT'L)	15 205-730-5499	80	PASSPORT DESIGNS INC (N.A.)	277 415-726-0280
505	COMPUTER QUICK	32IS 14 415-861-8330	555-556	INTERNATIONAL THOMPSON PUB (INT'L)	72-73 +44(0)171-497-1426**	129	PC'S COMPLEAT	296-297 508-624-6400
119	COMPUTERLANE UNLIMITED	298 800-526-3482	141	IO TECH	312 216-439-4091	234	PERSOFT INC	149 800-368-5283
137	COMPUTERWISE	317 800-255-3739	*	JAMECO ELECTRONICS	301 800-831-4242	148	PERSONAL TEX	317 800-808-7906
*	COPIA INTERNATIONAL LTD	146 708-682-8898	*	JDR MICRODEVICES	307 800-538-5000	166-167	PIKA TECHNOLOGIES	310 613-591-1555
64	COREL CD OFFICE COMPANION	31 613-728-0826 ext 3080	<b>K</b>			81-82	PINNACLE MICRO	7 714-727-3300
219	COREL DRAW 6	143 613-728-0826 ext 3080	142	KILA	311 303-444-7737	235	PKWARE INC	142 414-354-8699
200-201	CORPORATE UPGRADES	314 800-240-6190	225-226	KINGSTON TECHNOLOGY	198 714-435-2600	236	PKWARE INC	156 414-354-8699
95	CREATIVE LABS INC	36 800-998-5227	72-73	KINGSTON TECHNOLOGY	258 714-438-1850	318-319	POLYCON GMBH DATA SYS	195 +49-521-9861322**
287-288	CYBEX CORP	176 205-430-4030**	103	KL GROUP	220 800-663-4723	237	POPIN SW & SYSTEMS INC (N.A.)	120 212-571-3434
120-121	CYBEX CORP	299 205-430-4030**	315	KLEINMANN	187 +49-7128-922922**	90-100	PROXIMA CORP	200 800-447-7694
122-123	CYBEX CORP	302 205-430-4030**	<b>L</b>			268	PSINET (N.A.)	127 800-PSI-0852 dept 316
506-507	CYBEX CORP (INT'L)	CIII 205-430-4030**	<b>M</b>			<b>Q</b>		
<b>D</b>						238	QNX SOFTWARE SYSTEMS LTD	98 800-576-0566 ext 1007
306	DALLAS SEMICONDUCTOR	184 800-258-5061				307-308	QUALCOMM	181 800-2EUDORA
						149	QUALSTAR CORP	316 800-468-0680



# ADVERTISER CONTACT INFORMATION

Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.	Inquiry No.	Page No.	Phone No.
239-240	QUARTERDECK OFFICE SYSTEMS	124	310-392-9851	275-276	SOFTWARE AMERICA INC	146	303-670-5345	
241-242	QUATECH INC	59	800-553-1170	109-110	SOLID COMPUTER GMBH	255	+49-89-3159146**	ext 28
83-84	QUATECH INC	290	800-553-1170	562	SOLID COMPUTER GMBH (INTL)	139	+49-89-3159146**	
<b>R</b>				277	SPRINT BUSINESS SVCS (N.A.)	83	800-669-4700	
326-327	RAIDTEC CORP	182	404-664-6066	198-199	STARTECH COMPUTER PROD	311	800-265-1844	ext 231
523-524	RAIMA CORP	3215 15	206-557-0200	89	STATSOFT	205	918-583-4149	
243	RAINBOW TECHNOLOGIES	87	800-852-8569	346	STORAGE SOLUTIONS	265	203-325-0035	
280	RAVE COMPUTER ASSOCIATES	138	800-966-RAVE	101	SUPRA CORP (N.A.)	217	800-450-9760	ext 9AP4
172-173	RCI	310	800-RCI-8090	93	SYMANTEC	21-23	800-450-9760	ext 9AP5
			ext 71	347	SYMANTEC	43	800-450-9760	ext 9AP5
126	RECORTEC INC	305	800-729-7654	348	SYMANTEC	45	800-450-9760	ext 9AP6
350	RECORTEC INC	305	800-729-7654	349	SYMANTEC	47	800-450-9760	ext 9AP7
351	RECORTEC INC	305	800-729-7654	94	SYMANTEC	219	800-628-4777	ext 9AP3
352	RECORTEC INC	305	800-729-7654					
150	RHETOREX INC	311	408-370-0881					
299-300	ROSE ELECTRONICS	186	800-333-9343					
85-86	ROSS TECHNOLOGY INC	245	800-774-7677					
<b>S</b>				<b>T</b>				
263	SAG ELECTRONICS	108	508-682-0055	256-257	TADPOLE TECHNOLOGY	159	800-232-6656	
274	SAMSUNG ELECTRONICS	129	201-229-4053	189-190	TALKIE	317	800-TALKIE-4	
87-88	SAMTRON DISPLAYS INC (N.A.)	209	310-537-7000	152	TALKING TECHNOLOGY INC	311	800-685-4884	
260-261	SCEPTRE TECHNOLOGIES	144	800-788-2878	90	TEKTRONIX	39	800-835-6100	ext 1037
211	SCI TRAC PRODUCTS	313	412-367-7063	330	TELEADAPTER SYSTEMS INC	184	800-997-7762	
309	SCITECH INTERNATIONAL	183	800-622-3345	247-248	TEXAS INSTRUMENTS	94-95	800-TI-TEXAS	
244-245	SEALVIEW SYSTEMS INC	162	803-843-4343	272-273	TEXAS MICRO	101	713-541-8200	
321-322	SEH COMPUTERTECHNIK GMBH	195	+49-521-94226-0	*	TEXAS MICRO (N.A.)	100A-B	713-541-8200	
208-209	SERMAX	315	800-209-7126	343	TOPSPEED	194	305-785-4555	
168-169	SHAFFSTALL CORP	316	800-248-3475	249	TOSHIBA AMERICA INC	76-77	800-457-7777	
158-159	SIGMA TECH SOFTWARE	311	818-368-6132	156	TRI VALLEY TECHNOLOGY INC	312	510-447-2030	
*	SILICON GRAPHICS	93	800-636-8184	250-251	TRIPP LITE	154	312-755-8741	
			ext D440	163	TTI TECHNOLOGIES INC	315	800-541-1943	
187	SILICONRAX	312	800-700-8560	<b>U</b>				
151	SILICONSOFT INC	313	800-969-4411	112-113	UNIDIRECT	240	800-755-UNIX	
266-267	SMITH MICRO SOFTWARE INC	157	714-362-2345	188	UNITED EDUCATION CENTERS	317	800-877-4889	
262	SOFTARC	96	905-415-7151**					
320	SOFTBLOX INC	196	800-434-0202					
246	SOFTWARE SECURITY	150	203-656-9322**					

<b>V</b>			
337-338	VEROT PUBLISHING	173	800-771-EASY
153	VIDEX INC	310	503-758-0521
252-253	VIEWSOFT	66-67	909-869-7976
333-334	VISUAL NUMERICS	171	800-364-8880

<b>W</b>			
91	WALKER, RICHER & QUINN	221	206-217-7100
254	WATCOM C/C++10.5	123	519-886-3700
92	WATCOM SQL	27	519-886-3700
335-336	WESTERN DESIGN CENTER	185	802-962-4545
213	WETEX INTERNATIONAL	314	800-75WETEX
313	WIBU (INTL)	187	+49-721-93172-22**
313	WIBU (U.S.)	187	800-986-6578
104	WINBOOK (N.A.)	11	800-468-0366
154	WINTK CORP	317	800-742-6809
127	WORLDWIDE TECHNOLOGIES	304	215-922-0116**

<b>Z</b>			
255	ZEOS INTERNATIONAL	118-119	800-554-5226
155	Z-WORLD ENGINEERING	316	916-757-3737
258-259	ZYXEL USA	163	714-693-0808

\* Correspond directly with company.  
\*\* Indicates FAX Number

## Regional Edition Definitions:

DM - Ads only appear in Demographic Edition  
EUROPE - Ads only appear in Europe Edition  
IS/INTL - Ads only appear in International Edition  
MW - Ads only appear in Midwest Region Edition  
N.A. - Ads only appear in North America Edition  
NE - Ads only appear in Northeast Region Edition  
PC - Ads only appear in Pacific Coast Region Edition  
SO - Ads only appear in Southern Region Edition  
U.S. - Ads only appear in U.S. Edition  
WORLD - Ads only appear in World Edition

## BYTE ADVERTISING SALES STAFF

John M. Griffin, V.P. of Sales, 1221 Avenue of Americas, 28th Floor, New York, NY 10020, Tel: (212) 512-2363, Fax: (212) 512-2075  
Diane Lieberman, Director, Sales Operations, One Phoenix Mill Lane, Peterborough, NH 03458, Tel: (603) 924-2518, Fax: (603) 924-2683

**NEW ENGLAND**  
ME, NH, Upstate NY, VT, MA, RI, CT, ONTARIO  
CANADA & EASTERN CANADA  
Sanford L. Fishel (617) 860-6344  
Merle Model (617) 860-6221  
McGraw-Hill Publications  
24 Hartwell Avenue  
Lexington, MA 02173  
FAX: (617) 860-6899

**NATIONAL ACCOUNTS**  
Jonathan Sawyer (603) 924-2665  
BYTE Publications  
One Phoenix Mill Lane  
Peterborough, NH 03458  
FAX: (603) 924-2683

**EAST COAST**  
NY, NY, CT, DE, DC, MD, PA, VA  
Michael Feinberg (212) 512-4811  
Susan Rastellini (617) 860-6265  
McGraw-Hill Publications  
1221 Avenue of Americas—28th Floor  
New York, NY 10020  
FAX: (212) 512-2075

**SOUTHEAST**  
NC, SC, GA, FL, AL, TN, MS, AR, LA, KY, WV  
MaryAnn Goulding (404) 843-4782  
Margot L. Swanson (603) 924-2651  
McGraw-Hill Publications  
4170 Ashford-Dumwoody Rd., Suite 520  
Atlanta, GA 30319  
FAX: (404) 252-4056

**MIDWEST**  
IL, MO, KS, IA, ND, SD, MN, WI, NE, IN, MI, OH  
Lori Silverstein (614) 899-4908  
Ed Ware (603) 924-2664  
McGraw-Hill Publications  
321 Eastwind Drive, Suite 118  
Westerville, OH 43081  
FAX: (614) 899-4999

**SOUTHWEST, ROCKY MOUNTAIN**  
CO, OK, TX  
Jennifer Walker (214) 701-8496  
Kevin Lary (603) 924-2527  
McGraw-Hill Publications  
14850 Quorum Dr., Suite 380  
Dallas, TX 75240  
FAX: (214) 991-6208

**NORTH PACIFIC**  
NORTH CARA, OR, ID, MT, WY, UT  
Roy J. Kops (415) 513-6861  
James Ball (603) 924-2662  
SILICON VALLEY, HI, WA, AK, W, CANADA  
James Ball (603) 924-2662  
McGraw-Hill Publications  
1900 O'Farrell Street, Suite 200  
San Mateo, CA 94403  
FAX: (415) 513-6867

**SOUTH PACIFIC**  
SOUTHERN CALIFORNIA, AZ, NM, NV  
Beth Dudas (714) 753-8140  
Mark Speros (714) 753-8140  
Brad Dixon (603) 924-2574  
McGraw-Hill Publications  
15635 Alton Pkwy., Suite 290  
Irvine, CA 92718  
FAX: (714) 753-8147

**Peterborough, NH Office: Inside Sales FAX: 603-924-2683 Advertising FAX: 603-924-7507**

**Hardware/Software Showcase**  
The Buyer's Mark/Classifieds  
Northern U.S.: Mark Stone (603) 924-2695  
Southern U.S.: Ellen Perham (603) 924-2598  
BYTE Publications  
One Phoenix Mill Lane  
Peterborough, NH 03458

**BYTE Deck**  
Brian Higgins (603) 924-2596  
BYTE Publications  
One Phoenix Mill Lane  
Peterborough, NH 03458

**EURO-DECK**  
Joseph Mabe (603) 924-2533  
BYTE Publications  
One Phoenix Mill Lane  
Peterborough, NH 03458

**Regional Advertising Sections**  
Brian Higgins (603) 924-2596  
BYTE Publications  
One Phoenix Mill Lane  
Peterborough, NH 03458

## INTERNATIONAL ADVERTISING SALES STAFF

Gary Lucas, European Sales Director, 34 Dover Street, London W1X 4BR, England, Tel: +44 171 4956780, Fax: +44 171 4956734

**UNITED KINGDOM, BENELUX**  
Gary Lucas (+44 171 495 6780)  
Jonathan McGowan  
(+44 171 495 6781)  
McGraw-Hill Inc.  
34 Dover St.  
London W1X 4BR  
England  
FAX: +44 171 4956734

**GERMANY, SWITZERLAND, AUSTRIA**  
Jürgen Heise  
McGraw-Hill Inc.  
Liebigstrasse 19  
D-60333 Frankfurt  
Germany  
Tel: +49 69 7140 7140  
FAX: +49 69 7140 7146

**ITALY, FRANCE, SPAIN, PORTUGAL, SCANDINAVIA**  
Zenia Coupé, Amanda Blaskett  
A-Z International Sales Ltd.  
70 Chalk Farm Road  
London NW1 8AN  
England  
Tel: +44 171 2843171  
FAX: +44 171 2843174

**ISRAEL**  
Dan Aronovitch  
DARA International  
41 Ravutski  
Rafanara 43220  
Israel  
Tel: +972 9 919544  
FAX: +972 9 981934

**TAIWAN**  
Janet Wang  
Third Wave Publishing Corp.  
2nd Fl., No. 19-2, Lane 231  
Fu Hsing North Road  
Taipei 105, Taiwan  
R.O.C.  
Tel: +886 2 7136959  
FAX: +886 2 7189467

**HONG KONG**  
Zoe Yen  
Third Wave Publishing Corp.  
Unit 2, 6F Hing Wah Center  
82-84 To Kwa Wan Road  
Kowloon, Hong Kong  
Tel: +852 764 3830  
FAX: +852 764 3857

**KOREA**  
Young-Seoh Chinn  
JES Media International  
6th Fl., Donghye Bldg.  
47-16, Myungil-Dong  
Kangdong-Gu  
Seoul 134-070, Korea  
Tel: +82 2 4813411  
FAX: +82 2 4813414

**JAPAN**  
Hirokazu Morita  
Japanese Advertising  
Communications, Inc.  
Three Star Building  
3-10-3 Kanda Jimbocho  
Chiyoda-ku, Tokyo 101  
Japan  
Tel: +81 3 32614591  
FAX: +81 3 32616126

**AUSTRALIA**  
Phil Bush  
National Advertising Services  
7-13 Parramatta Street  
Cremorne NSW 2090,  
Australia  
Tel: +61 2 908 9329  
FAX: +61 2 953 8274

**SINGAPORE, INDIA, INDONESIA, PAKISTAN, PHILIPPINES, OTHER ASIAN AND PACIFIC COUNTRIES**  
Janet Wang  
Third Wave Publishing Corp.  
2nd Fl., No. 19-1, Lane 231  
Fu Hsing North Road  
Taipei 105, Taiwan  
R.O.C.  
Tel: +886 2 7136959 ext. 226  
FAX: +886 2 7189467

**MALAYSIA**  
H.K. Lim  
Servex (Malaysia) Sdn. Bhd.  
5th Floor, Bena Tower  
160, Jalan Ampang  
50450 Kuala Lumpur  
Malaysia  
Tel: +60 3 2624592  
FAX: +60 3 2624591

Subscription Customer Service  
U.S. 1-800-232-2983  
Outside U.S. +1-609-426-7676

For a New Subscription  
U.S. 1-800-257-9402  
Outside U.S. +1-609-426-5526



# INDEX TO ADVERTISED PRODUCTS

For **FREE** product information from individual advertisers, circle the corresponding inquiry numbers on the response card!

To receive information for an entire product category, circle the category number on the response card!

Category No.  
Inquiry No.

Page No.

## HARDWARE

### 1 ACCESSORIES/SUPPLIES

264-265	AERONICS INC	141
*	ANTHRO CORP	208
203-204	COMPUTER GATE	309
170	HALL RESEARCH & TECHNOLOGIES I	309
210	LYBEN COMPUTER SYSTEMS	309

### 2 ADD-IN BOARDS

501-502	BOCA RESEARCH INC (INT'L)	120
196-197	CAMELEON TECHNOLOGY INC	314
65-66	DIGI INTERNATIONAL	207
*	FUTURE MICRO INC	306
206-207	GLOBETEK	309
*	JAMECO ELECTRONICS	301
297-298	OMNICOMP GRAPHICS CORPORATION	167
146-147	OPUS SYSTEMS	309
166-167	PIKA TECHNOLOGIES	310
241-242	QUATECH INC	59
83-84	QUATECH INC	290
244-245	SEALEVEL SYSTEMS INC	162
152	TALKING TECHNOLOGY INC	311

### 3 BAR CODING

210	LYBEN COMPUTER SYSTEMS	309
153	VIDEX INC	310

### 4 COMMUNICATIONS/NETWORKING

176-177	ADVANCED IMAGE COMMUNICATIONS	313
284	ALTEX ELECTRONICS	188
534-535	AXIS COMMUNICATIONS (INT'L)	127
331-332	BUROBOTICS	172
220-221	DATAPRODUCTS	153
*	DELL COMPUTER CORP (N.A.)	32NA 3,5
*	DELL COMPUTER CORP (N.A.)	72-73
557-558	ELPROMA ELECTRONICA BV	32IS 18
538-539	ERGOTRON EUROPE	32IS 13
*	IBM SERVERS (N.A.)	71
*	IBM SERVERS (N.A.)	69
225-226	KINGSTON TECHNOLOGY	198
565-566	LANNET DATA COMMUNICATIONS (INT'L)	227
107	MEGAHERTZ CORPORATION (N.A.)	32NA 1
178	NEWVOICE	310
146-147	OPUS SYSTEMS	309
166-167	PIKA TECHNOLOGIES	310
318-319	POLYCON GMBH DATA SYSTEMS	195
172-173	RCI	310
150	RHETOREX INC	311
299-300	ROSE ELECTRONICS	186
244-245	SEALEVEL SYSTEMS INC	162
321-322	SEH COMPUTERTECHNIK GMBH	195
158-159	SIGMA TECH SOFTWARE	311
109-110	SOLID COMPUTER GMBH	255
562	SOLID COMPUTER GMBH (INT'L)	139
277	SPRINT BUSINESS SERVICES (N.A.)	83
198-199	STARTECH COMPUTER PRODUCTS	311
152	TALKING TECHNOLOGY INC	311

### 5 COMPUTER SYSTEMS

133-134	ANGLE TECHNOLOGY INC	303
*	APPLE COMPUTER INC	111
*	APPLE COMPUTER INC	113
*	APPLE COMPUTER INC (U.S.)	32NA-H
271	AT&T GLOBAL INFO SOLS (N.A.)	56-57
291	DATALUX CORPORATION	169
*	DELL COMPUTER CORP (N.A.)	CIH
*	DELL COMPUTER CORP (N.A.)	CIIV
560-561	DIGICOM (INT'L)	62-63
*	GATEWAY 2000	88-89
*	IBM PC 700 (N.A.)	15-17
*	IBM SERVERS (N.A.)	71
*	IBM SERVERS (N.A.)	69
140	INTEGRAND RESEARCH	311
142	KILA	311
98	MICRON COMPUTER	CIH,1

Category No.  
Inquiry No.

Page No.

78	NSTL	266
514-515	OLIVETTI S.P.A. (INT'L)	16-17
146-147	OPUS SYSTEMS	309
280	RAVE COMPUTER ASSOCIATES	138
126	RECORTEC INC	305
350	RECORTEC INC	305
351	RECORTEC INC	305
352	RECORTEC INC	305
263	SAG ELECTRONICS	108
*	SILICON GRAPHICS	93
187	SILICONRAX	312
109-110	SOLID COMPUTER GMBH	255
256-257	TADPOLE TECHNOLOGY	159
156	TRI VALLEY TECHNOLOGY INC	312
255	ZEOS INTERNATIONAL	118-119

### 6 DATA ACQUISITION

136	AMERICAN ADVANTECH	312
138	GAGE APPLIED SCIENCES, INC	312
182-183	INNOVENTION INDUSTRIES INC	312
141	IO TECH	312
144	LAWSON LABS INC	312
*	MICROSTAR LABORATORIES	313
241-242	QUATECH INC	59
83-84	QUATECH INC	290
211	SCI TRAN PRODUCTS	313
151	SILICONSOFT INC	313
272-273	TEXAS MICRO	101

### 53 DIAGNOSTIC EQUIPMENT

301	MICRO 2000	190
302	MICRO 2000	191

### 7 DISK & OPTICAL DRIVES

135	ASHTK INC	295
*	COMPUTER PURCHASER'S HELP LINE	182
160-161	GRANITE DIGITAL	313
563	HITACHI (INT'L)	83
72-73	KINGSTON TECHNOLOGY	258
225-226	KINGSTON TECHNOLOGY	198
294-295	MICRO SOLUTIONS COMP PROD	179
341-342	MICROPOLIS CORP (NAM)	164
79	PANASONIC COMMUNICATIONS & SYS	253
81-82	PINNACLE MICRO	7
326-327	RAIDTEC CORPORATION	182

### 8 DISKETTES/DUPPLICATORS

264-265	AERONICS INC	141
---------	--------------	-----

### 9 FAX BOARDS/MACHINES

176-177	ADVANCED IMAGE COMMUNICATIONS	313
331-332	BUROBOTICS	172
166-167	PIKA TECHNOLOGIES	310
266-267	SMITH MICRO SOFTWARE INC	157
101	SUPRA CORPORATION (N.A.)	217

### 11 KEYBOARDS

291	DATALUX CORPORATION	169
174-175	ELMA ELECTRONIC	313
139	HOOLEON CORPORATION	314

### 12 LAN HARDWARE

202	ANTEC	314
501-502	BOCA RESEARCH INC (INT'L)	120
503-504	COMPEX INC (INT'L)	81
287-288	CYBEX CORPORATION	176
120-121	CYBEX CORPORATION	299
122-123	CYBEX CORPORATION	302
506-507	CYBEX CORPORATION (INT'L)	CIH
*	DATA COMMUNICATIONS (INT'L)	225
67	DISTRIBUTED PROCESSING TECH	257
538-539	ERGOTRON EUROPE	32IS 13
124-125	FIRST SOURCE INT'L	294
565-566	LANNET DATA COMMUNICATIONS (INT'L)	227
278-279	MAXTECH CORP (N.A.)	103
263	SAG ELECTRONICS	108
321-322	SEH COMPUTERTECHNIK GMBH	195
109-110	SOLID COMPUTER GMBH	255

Category No.  
Inquiry No.

Page No.

### 13 LAPTOPS & NOTEBOOKS

312	BADGER COMPUTER	197
*	COMPAQ NOTEBOOKS (N.A.)	32NA 6-7
200-201	CORPORATE UPGRADES	314
526-527	ECEL (INT'L)	103
528-529	ECEL (INT'L)	105
162	EDUCALC	314
525	FIRST INTERNATIONAL COMPUTER	32IS 2
*	JDR MICRODEVICES	307
305	MICRO-INTERNATIONAL INC	175
516-517	OLIVETTI S.P.A. (INT'L)	56-57
129	PC'S COMPLEAT	296-297
260-261	SCEPTRE TECHNOLOGIES	144
256-257	TADPOLE TECHNOLOGY	159
247-248	TEXAS INSTRUMENTS	94-95
249	TOSHIBA AMERICA INC	76-77
104	WINBOOK (NAM)	11
255	ZEOS INTERNATIONAL	118-119

### 14 MAIL ORDER

284	ALTEX ELECTRONICS	188
118	COMPUTER DISCOUNT WAREHOUSE	292-293
119	COMPUTERLANE UNLIMITED	298
*	JAMECO ELECTRONICS	301
229	MOTOROLA	115
129	PC'S COMPLEAT	296-297
213	WETEX INTERNATIONAL	314
127	WORLDWIDE TECHNOLOGIES	304

### 15 MEMORY/CHIPS/UPGRADES

*	ADVANCED MICRO DEVICES (N.A.)	106-107
196-197	CAMELEON TECHNOLOGY INC	314
*	COMPUTER PURCHASER'S HELP LINE	182
124-125	FIRST SOURCE INT'L	294
*	FUTURE MICRO INC	306
*	JAMECO ELECTRONICS	301
225-226	KINGSTON TECHNOLOGY	198
310-311	L A TRADE	170
85-86	ROSS TECHNOLOGY INC	245
208-209	SERMAX	315
163	TTI TECHNOLOGIES INC	315
335-336	WESTERN DESIGN CENTER	185
127	WORLDWIDE TECHNOLOGIES	304

### 16 MISCELLANEOUS HARDWARE

106	CALIFORNIA PC PRODUCTS INC	276
191-192	HOEI SANGYO CO LTD	315
*	MOTOROLA	134-135
*	MOTOROLA	136-137
*	NINTENDO (N.A.)	62-63
244-245	SEALEVEL SYSTEMS INC	162

### 17 MODEMS/MULTIPLEXORS

176-177	ADVANCED IMAGE COMMUNICATIONS	313
501-502	BOCA RESEARCH INC (INT'L)	120
331-332	BUROBOTICS	172
*	JDR MICRODEVICES	307
278-279	MAXTECH CORP (N.A.)	103
107	MEGAHERTZ CORPORATION (N.A.)	32NA 1
266-267	SMITH MICRO SOFTWARE INC	157
101	SUPRA CORPORATION (N.A.)	217
330	TELEADAPTER SYSTEMS INC	184
258-259	ZYXEL USA	163

### 18 MONITORS & TERMINALS

132	ACTION	308
291	DATALUX CORPORATION	169
278-279	MAXTECH CORP (N.A.)	103
230-231	NANAO USA CORP (N.A.)	81
130-131	ORCHESTRA MULTISYSTEMS	180
274	SAMSUNG ELECTRONICS	129
87-88	SAMTRON DISPLAYS INC (N.A.)	209
252-253	VIEWSONIC	66-67

### 19 MULTIMEDIA/CD-ROM

205	ANALOG WAY	315
185-186	BOXLIGHT CORPORATION	316
95	CREATIVE LABS INC	36



# FREE PRODUCT INFORMATION

For free product information from companies featured in this issue, circle the appropriate inquiry number below and mail this card today. For quickest response, fax to 1-416-620-9790!

## Product Category Information

To receive information for an entire category, circle the appropriate number on the adjacent card.

### Hardware

Accessories/Supplies	1
Add-In Boards	2
Bar Coding	3
Communications/Networking	4
Computer Systems	5
Data Acquisition	6
Diagnostic Equipment	53
Disks & Optical Drives	7
Diskettes/Duplicators	8
Fax Boards/Machines	9
Graphics Tablets/Mice/	
Pen Input	10
Keyboards	11
LAN Hardware	12
Laptops & Notebooks	13
Mail Order	14
Memory/Chips/Upgrades	15
Miscellaneous Hardware	16
Modems/Multiplexors	17
Monitors & Terminals	18
Multimedia/CD-ROM	19
PCMCIA	57
Printers/Plotters	20
Programmable Hardware	21
RAID Drive Arrays	56
Scanners/OCR/Digitizers	22
Security	52
Tape Drives	23
UPS/Power Management	24
Voice Technology	55

### Software

Business	25
CAD/CAM	26
Communications/Networking	27
Data Acquisition	28
Database	29
Educational	30
Engineering/Scientific	31
Entertainment	32
Graphics	33
Macintosh	34
Mail Order	35
Mathematical/Statistical	36
Miscellaneous Software	37
On-Line Services	38
Operating Systems	39
OS/2	54
Programming Languages/	
Tools	40
SCSI/Peripheral Interfaces	59
Security	41
Shareware	42
Software Duplication	43
Spreadsheets	44
Unix	45
Utilities	46
Windows	47
Word Processing/DTP	48

### General

Books/Publications	49
Recruitment	50
Miscellaneous	51

Fill out this coupon carefully. Please Print.

Name \_\_\_\_\_ Title \_\_\_\_\_  
 Company \_\_\_\_\_ Address \_\_\_\_\_  
 City \_\_\_\_\_ Country \_\_\_\_\_ Code \_\_\_\_\_  
 Phone \_\_\_\_\_ Fax \_\_\_\_\_

A. My job function is best classified as (check one):

- 1 [ ] Company Management  
 2 [ ] IS/MIS/IT Management  
 3 [ ] Systems Engineering/Integration  
 4 [ ] Systems/Networking Consulting  
 5 [ ] Departmental Management (non-IS/MIS)  
 6 [ ] Technical Services Support  
 7 [ ] Other (please describe)

13 [ ] Other (please specify):

C. Please indicate which specific fields of interest are important to you so that BYTE may serve you with supplemental information that best meets your needs (select all that apply):

- 14 [ ] UNIX and Workstations  
 15 [ ] Networking (LANs, WANs, and Telecommunications)  
 16 [ ] Multimedia  
 17 [ ] Reselling/Systems Integration  
 18 [ ] Applications Development  
 19 [ ] Other (explain):

D. My responsibilities require that I be involved with the following operating system environments (check all that apply):

- 20 [ ] DOS  
 21 [ ] OS/2  
 22 [ ] Mac/OS

- 23 [ ] UNIX (any, including Solaris)  
 24 [ ] Windows  
 25 [ ] Windows/NT  
 26 [ ] NetWare  
 27 [ ] Other (please describe):

E. The number of employees at my location and company-wide area (check one in each column):

	At My Location	Company-Wide
10,000 or more	28 [ ]	33 [ ]
5,000 to 9,999	29 [ ]	34 [ ]
1,000 to 4,999	30 [ ]	35 [ ]
100 to 999	31 [ ]	36 [ ]
Under 100	32 [ ]	37 [ ]

September 1995

90 97 99

Valid until November 30, 1995

### Inquiry Numbers 1-187

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85
86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102
103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
120	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136
137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170
171	172	173	174	175	176	177	178	179	180	181	182	183	184	185	186	187

### Inquiry Numbers 375-561

375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391
392	393	394	395	396	397	398	399	400	401	402	403	404	405	406	407	408
409	410	411	412	413	414	415	416	417	418	419	420	421	422	423	424	425
426	427	428	429	430	431	432	433	434	435	436	437	438	439	440	441	442
443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459
460	461	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476
477	478	479	480	481	482	483	484	485	486	487	488	489	490	491	492	493
494	495	496	497	498	499	500	501	502	503	504	505	506	507	508	509	510
511	512	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527
528	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544
545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560	561

### Inquiry Numbers 749-935

749	750	751	752	753	754	755	756	757	758	759	760	761	762	763	764	765
766	767	768	769	770	771	772	773	774	775	776	777	778	779	780	781	782
783	784	785	786	787	788	789	790	791	792	793	794	795	796	797	798	799
800	801	802	803	804	805	806	807	808	809	810	811	812	813	814	815	816
817	818	819	820	821	822	823	824	825	826	827	828	829	830	831	832	833
834	835	836	837	838	839	840	841	842	843	844	845	846	847	848	849	850
851	852	853	854	855	856	857	858	859	860	861	862	863	864	865	866	867
868	869	870	871	872	873	874	875	876	877	878	879	880	881	882	883	884
885	886	887	888	889	890	891	892	893	894	895	896	897	898	899	900	901
902	903	904	905	906	907	908	909	910	911	912	913	914	915	916	917	918
919	920	921	922	923	924	925	926	927	928	929	930	931	932	933	934	935

### Inquiry Numbers 1123-1309

1123	1124	1125	1126	1127	1128	1129	1130	1131	1132	1133	1134	1135	1136	1137	1138	1139
1140	1141	1142	1143	1144	1145	1146	1147	1148	1149	1150	1151	1152	1153	1154	1155	1156
1157	1158	1159	1160	1161	1162	1163	1164	1165	1166	1167	1168	1169	1170	1171	1172	1173
1174	1175	1176	1177	1178	1179	1180	1181	1182	1183	1184	1185	1186	1187	1188	1189	1190
1191	1192	1193	1194	1195	1196	1197	1198	1199	1200	1201	1202	1203	1204	1205	1206	1207
1208	1209	1210	1211	1212	1213	1214	1215	1216	1217	1218	1219	1220	1221	1222	1223	1224
1225	1226	1227	1228	1229	1230	1231	1232	1233	1234	1235	1236	1237	1238	1239	1240	1241
1242	1243	1244	1245	1246	1247	1248	1249	1250	1251	1252	1253	1254	1255	1256	1257	1258
1259	1260	1261	1262	1263	1264	1265	1266	1267	1268	1269	1270	1271	1272	1273	1274	1275
1276	1277	1278	1279	1280	1281	1282	1283	1284	1285	1286	1287	1288	1289	1290	1291	1292
1293	1294	1295	1296	1297	1298	1299	1300	1301	1302	1303	1304	1305	1306	1307	1308	1309

### Inquiry Numbers 188-374

188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204
205	206	207	208	209	210	211	212	213	214	215	216	217	218	219	220	221
222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238
239	240	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255
256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272
273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289
290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306
307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323
324	325	326	327	328	329	330	331	332	333	334	335	336	337	338	339	340
341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357
358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373	374

### Inquiry Numbers 562-748

562	563	564	565	566	567	568	569	570	571	572	573	574	575	576	577	578
579	580	581	582	583	584	585	586	587	588	589	590	591	592	593	594	595
596	597	598	599	600	601	602	603	604	605	606	607	608	609	610	611	612
613	614	615	616	617	618	619	620	621	622	623	624	625	626	627	628	629
630	631	632	633	634	635	636	637	638	639	640	641	642	643	644	645	646
647	648	649	650	651	652	653	654	655	656	657	658	659	660	661	662	663
664	665	666	667	668	669	670	671	672	673	674	675	676	677	678	679	680
681	682	683	684	685	686	687	688	689	690	691	692	693	694	695	696	697
698	699	700	701	702	703	704	705	706	707	708	709	710	711	712	713	714
715	716	717	718	719	720	721	722	723	724	725	726	727	728	729	730	731
732	733	734	735	736	737	738	739	740	741	742	743	744	745	746	747	748



# FREE PRODUCT INFORMATION

*For free product information from companies featured in this issue, circle the appropriate inquiry number below and mail this card today. For quickest response, fax to 1-416-620-9790!*

See reverse side  
for card.

**1. For FREE product information from individual companies, circle the corresponding inquiry numbers on the Response Card!**

**2. Print Your Name and Address**

Answer questions "A" through "E" and mail or fax card to 1-416-620-9790.

**3. Product information will be rushed to you from the selected companies!**

**BYTE**

TNT MAILFAST

FRG/BOS/700252/MO1

P.O. Box 66

Hounslow

TW5 9RT

England

Place  
Postage  
Here

**BYTE**



# INDEX TO ADVERTISED PRODUCTS

Category No. Inquiry No.		Page No.	Category No. Inquiry No.		Page No.	Category No. Inquiry No.		Page No.
567-568	ELEKTROSON BV (INT'L)	217	549-550	LOCUS COMPUTING (INT'L)	69	343	TOPSPEED	194
*	FUTURE MICRO INC	306	*	MICROSOFT CORPORATION	2-3	254	WATCOM C/C++10.5	123
191-192	HOEI SANGYO CO LTD	315	*	MICROSOFT CORPORATION	12-13	92	WATCOM SQL	27
564	INFOCUS (INT'L)	11	296	MUSTANG SOFTWARE	186	<b>41 SECURITY</b>		
283	INSTINCT SRL	155	234	PERFOTO INC	149	214-215	ALADDIN KNOWLEDGE SYSTEMS	50-52
116-117	MRT	241	307-308	QUALCOMM	181	306	DALLAS SEMICONDUCTOR	184
212	PANELIGHT	316	266-267	SMITH MICRO SOFTWARE INC	157	508-509	ELIASHIM MICROCOMPUTERS	32IS 4
80	PASSPORT DESIGNS INC (N.A.)	277	262	SOFTARC	96	510	EUTRON	32IS 20
99-100	PROXIMA CORPORATION	200	189-190	TALKIE	317	511-512	FAST HARDLOCK	32IS 9
*	SILICON GRAPHICS	93	91	WALKER, RICHER & QUINN	221	281	MARX INTERNATIONAL	162
<b>20 PRINTERS/PLOTTERS</b>			<b>28 DATA ACQUISITION</b>			243	RAINBOW TECHNOLOGIES	87
220-221	DATAPRODUCTS	153	521-522	NATIONAL INSTRUMENTS	32IS 10	246	SOFTWARE SECURITY	150
557-558	ELPROMA ELECTRONICA BV	32IS 18	<b>29 DATABASE</b>			313-315	WIBU	187
*	HEWLETT PACKARD	61	137	COMPUTERWISE	317	<b>45 UNIX</b>		
210	LYBEN COMPUTER SYSTEMS	309	542	HYPERSYSTEMS	32IS 24	303-304	AGE LOGIC	174
536	MANNESSMANN TALLY	32IS 21	*	IBM DATA MANAGEMENT (N.A.)	28-29	*	COPIA INTERNATIONAL LTD	146
90	TEKTRONIX	39	307-308	QUALCOMM	181	540-541	DISTINCT CORPORATION	32IS 16
<b>21 PROGRAMMABLE HARDWARE</b>			<b>30 EDUCATIONAL</b>			224	FRAME TECHNOLOGY (N.A.)	105
214-215	ALADDIN KNOWLEDGE SYSTEMS	50-52	551-552	LUNAR ENERGY CO	32IS 24	328-329	ICL (EMBLA)	168
*	DATA ACCESS CORP	192	*	MCGRAW HILL NRI (N.A.)	214A-B	518-519	INTERGRAPH CORPORATION (INT'L)	15
511-512	FAST HARDLOCK	32IS 9	188	UNITED EDUCATION CENTERS	317	103	KL GROUP	220
*	JDR MICRODEVICES	307	<b>31 ENGINEERING/SCIENTIFIC</b>			549-550	LOCUS COMPUTING (INT'L)	69
193	MICRO / SYS	315	545-546	EUROSOFT TECHNOLOGY	32IS 19	523-524	RAIMA CORP	32IS 15
243	RAINBOW TECHNOLOGIES	87	210	LYBEN COMPUTER SYSTEMS	309	275-276	SOFTWARE AMERICA INC	146
313-315	WIBU	187	164-165	OUTOKUMPU RESEARCH OY	317	112-113	UNIDIRECT	240
155	Z-WORLD ENGINEERING	316	148	PERSONAL TEX	317	<b>46 UTILITIES</b>		
<b>56 RAID DRIVE ARRAYS</b>			333-334	VISUAL NUMERICS	171	102	ALLMICRO	218
346	STORAGE SOLUTIONS	265	<b>33 GRAPHICS</b>			301	MICRO 2000	190
<b>22 SCANNERS/OCR/DIGITIZERS</b>			64	COREL CD OFFICE COMPANION	31	302	MICRO 2000	191
216-217	BELL & HOWELL INC	130	219	COREL DRAW 6	143	235	PKWARE INC	142
282	MDI SYSTEMS LTD	90	317	EMATEK GMBH	189	236	PKWARE INC	156
<b>52 SECURITY</b>			103	KL GROUP	220	239-240	QUARTERDECK OFFICE SYSTEMS	124
214-215	ALADDIN KNOWLEDGE SYSTEMS	50-52	227-228	MICROGRAFX	161	93	SYMANTEC	21-23
511-512	FAST HARDLOCK	32IS 9	325	MIPS DATALINE AMERICA INC	193	347	SYMANTEC	43
243	RAINBOW TECHNOLOGIES	87	230-231	NANAO USA CORP (N.A.)	81	348	SYMANTEC	45
313-315	WIBU	187	80	PASSPORT DESIGNS INC (N.A.)	277	349	SYMANTEC	47
<b>23 TAPE DRIVES</b>			99-100	PROXIMA CORPORATION	200	<b>47 WINDOWS</b>		
264-265	AERONICS INC	141	<b>35 MAIL ORDER</b>			111	BBN SOFTWARE PRODUCTS (N.A.)	225
323-324	COMBYTE INC	166	118	COMPUTER DISCOUNT WAREHOUSE	292-293	*	COPIA INTERNATIONAL LTD	146
547-548	COMBYTE INC (INT'L)	CIV	505	COMPUTER QUICK	32IS 14	540-541	DISTINCT CORPORATION	32IS 16
68-69	EXABYTE CORPORATION	19	513	GREY MATTER LTD (INT'L)	71	105	FINSON	237
294-295	MICRO SOLUTIONS COMP PROD	179	<b>36 MATHEMATICAL/STATISTICAL</b>			70-71	FRONTIER TECHNOLOGIES	278
149	QUALSTAR CORP	316	145	NATIONAL INSTRUMENTS	318	181	FUZIWARE INC	318
168-169	SHAFFSTALL CORP	316	148	PERSONAL TEX	317	513	GREY MATTER LTD (INT'L)	71
<b>24 UPS/POWER MANAGEMENT</b>			89	STATSOFT	205	269-270	ICONOVEX INC	139
194-195	ACI	316	<b>37 MISCELLANEOUS SOFTWARE</b>			179-180	KUREO TECHNOLOGY INC	318
344	AMERICAN POWER CONVERSION	8-9	105	FINSON	237	*	MICROSOFT CORPORATION	2-3
222-223	DELTEC / NSSI	158	530	ON TIME MARKETING	32IS 22	*	MICROSOFT CORPORATION	12-13
232-233	MINUTEMAN	104	337-338	VEROT PUBLISHING	173	230-231	NANAO USA CORP (N.A.)	81
250-251	TRIPP LITE	154	<b>38 ON-LINE SERVICES</b>			93	SYMANTEC	21-23
<b>SOFTWARE</b>			450	BIX	329	348	SYMANTEC	45
<b>25 BUSINESS</b>			218	COMPUSERVE	117	349	SYMANTEC	47
111	BBN SOFTWARE PRODUCTS (N.A.)	225	292-293	GALACTICOMM INC	177	104	WINBOOK (NAM)	11
*	COMPUTER PURCHASER'S HELP LINE	182	296	MUSTANG SOFTWARE	186	<b>48 WORD PROCESSING/DTP</b>		
316	DESIGNER CHECKS	193	268	PSINET (N.A.)	127	224	FRAME TECHNOLOGY (N.A.)	105
105	FINSON	237	<b>39 OPERATING SYSTEMS</b>			269-270	ICONOVEX INC	139
*	IBM APPLICATIONS DEVELOPMENT	34-35	238	QNX SOFTWARE SYSTEMS LTD	98	<b>GENERAL</b>		
227-228	MICROGRAFX	161	239-240	QUARTERDECK OFFICE SYSTEMS	124	<b>49 BOOKS/PUBLICATIONS</b>		
99-100	PROXIMA CORPORATION	200	<b>40 PROGRAMMING LANGUAGES/TOOLS</b>			*	BUSINESS WEEK (INT'L)	277
<b>26 CAD/CAM</b>			157	BYTECH BUSINESS SYSTEMS	318	*	BYTE BACK ISSUES (INT'L)	209
285-286	AMERICAN SMALL BUSINESS COMP	178	559	CASPER	32IS 19	63	BYTE ON CD ROM	232
154	WINTERK CORP	317	*	COPIA INTERNATIONAL LTD	146	*	BYTE REPRINTS (CD & INT'L)	283
<b>27 COMMUNICATIONS/NETWORKING</b>			317	EMATEK GMBH	189	*	BYTE NETWORKING ON DISK	242
303-304	AGE LOGIC	174	513	GREY MATTER LTD (INT'L)	71	*	CHEMICAL ENGINEERING (INT'L)	28-29
*	BEAME & WHITESIDE SOFTWARE	32IS 6	103	KL GROUP	220	*	COMPUTER BOOK CLUB, THE	278A-B
531-532	BEAME & WHITESIDE SOFTWARE	32IS 7	143	LAHEY COMPUTER SYSTEMS	318	*	COMPUTER BOOK CLUB, THE	279
96-97	BEAME & WHITESIDE SOFTWARE (N.A.)	227	520	LOGIC PROGRAMMING ASSOCIATES	32IS 22	555-556	INTERNATIONAL THOMPSON PUB (INT'L)	72-73
559	CASPER	32IS 19	*	MICROWAY	204	*	OSBORNE MCGRAW-HILL	246-247
503-504	COMPEX INC (INT'L)	81	76	MKS / MORTICE KERN SYSTEMS	148	<b>51 MISCELLANEOUS</b>		
340	DELFINA WIN FAX PRO	78	77	NOBLENET	222	*	BYTE EDITORIAL SURVEY	282
353-356	DIALOGIC / STYLUS INNOV (INT'L)	210	184	OBJECT MANAGEMENT LABORATORY	318	*	BYTE EURODECK (INT'L)	107
353-354	DIALOGIC / STYLUS INNOV (N.A.)	210	108	OBJECTS INC	228	*	BYTE MOBILE OFFICE COMPUTING (U.S.)	283
540-541	DISTINCT CORPORATION	32IS 16	530	ON TIME MARKETING	32IS 22	*	BYTE READER	262
124-125	FIRST SOURCE INT'L	294	237	POPKIN S/W & SYSTEMS INC (N.A.)	120	*	BYTE SUB MESSAGE	278
70-71	FRONTIER TECHNOLOGIES	278	523-524	RAIMA CORP	32IS 15	*	BYTE WEARHOUSE	238
328-329	ICL (EMBLA)	168	320	SOFTBLOX INC	196	*	MCGRAW-HILL COMPANIES (INT'L)	106
			94	SYMANTEC	219	554	MESSE MUENCHEN GMBH (SYSTEMS 95)	32IS 23



# EDITORIAL INDEX

For more information on any of the companies covered in articles, columns, or news stories in this issue, circle the appropriate inquiry number on the response card. Each page number refers to the first page of the article or section in which the company name appears.

Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.	Inquiry No.	Page No.
<b>A</b>				<b>M</b>			
	Aamazing Technologies	97		1276	Lifelearn V	275	
1015	Aardvark Software	289			Logitech	32NA 4	
1320	Acadgraph	32IS 3		1147	Lotus Development	37, 54, 64, 99, 133, 145, 165, 215	
	Acer	32NA 4		<b>N</b>			
1332	A.D.D.E.	32IS 20		1333	Magenta	32IS 20	
	Adobe Systems	64, 99, 133, 239		1000	Marquis Computing	288	
981	AER Energy Resources	286			Mathemaesthetics	97	
	Altec Lansing	243		998	Matrox Electronic Systems	288	
	AMD	30, 74, 239		1229	McAfee Associates	37, 165	
1033	America Online	85, 229		1403	Mega Drive Systems	248	
1030	Apple Computer	32, 37, 54, 64, 99, 109, 133, 145, 151, 165, 215, 239, 32NA 4		1278	Megahertz	275	
	Aquiline	233		1313	Meiko	32IS 16	
1344	Arcom Control Systems	32IS 22		979	Micro Energetics	286	
1396	Artecon	248		1404	MicroNet Technology	248	
1013	Artisoft	64, 235, 289		1405	Micropolis	248	
	Ashton-Tate	64, 145		1237	Microsoft	26, 32, 37, 54, 64, 74, 91, 99, 109, 121, 125, 133, 145, 165, 201, 223, 229, 235, 275, 32NA 8, 32IS 3	
	AST Research	37		1236	Microsystems Software	37	
	AsusTek	32NA 4			MicroTek	32NA 4	
	AT&T	64, 79, 99, 125, 133, 151, 201, 215			Miro	32NA 4	
1335	ATMA Srl	32IS 21			Missing Link Computer Technology	97	
1145	Aurora Systems	215			Mitac	32NA 4	
	Autodesk	99, 275, 32IS 3			Motorola	54, 74, 79, 99, 263	
983,	Axis Communications	286			Moxa	32NA 4	
1324, 1330		32IS 17, 32IS 19		<b>O</b>			
<b>B</b>					NEC	37, 54, 201	
1008	Bananas Software	289			NEC Electronics	32NA 2	
	BehavHeuristics	97			Netscape	85, 133	
	Beige Bag Software	97		1355	Next Computer	54, 133, 32IS 24	
	Bentley Systems	243, 32IS 3			Night Diamond Software	97	
	Bio-Plum	97			No-Brainier Software	97	
	Bloomsbury Software Group	97		1146,	Novell	37, 64, 79, 99,	
	Boojum Computer Systems	97		1230		133, 201, 215, 275	
	Borland International	26, 64, 99, 133, 165, 275		977	Number Nine Visual Technology	287	
<b>C</b>				<b>P</b>			
	CADapult	97			Odin Research	97	
	Calculus	97			Okra Marketing	97	
1397	Clarion Advanced Storage	248		1151	Omnicomp Graphics	243	
	CNet	32NA 4			Onyx Computer	97	
	Cobalt Blue	97			O'Pin Systems	97	
	Commodore Business Systems	54, 74, 99			Oracle	37, 64, 79, 109	
	Compaq Computer	37, 54, 99, 201			Ozymandias Engineering	97	
1034	CompuServe	85, 99, 229		<b>R</b>			
1321	Computervision	32IS 3			Paradigm Concepts	97	
1315	Concurrent Computer	32IS 16			Pectronics	97	
1398	Conner Storage Systems	248		1347	Perihelion Technology	32IS 22	
	Cybermax	30		1406	Perisot Technology	248	
	Cykic Software	97			Phillips Electronics	32	
	Cyrix	30		1341	P.INK Software Engineering	32IS 21	
<b>D</b>					Plaid Brothers Software	97	
1399	Data Storage Marketing	248			Plain Jayne Software	97	
976	Dell Computer	37, 286		1407	Procom Technology	248	
991	Diamond Multimedia	287		1035	Prodigy	229	
	DiGi International	41			Prolab	32NA 4	
1400	Digital Equipment	37, 79, 99, 145, 151, 201, 248			Prometheus Products	97	
1275	Digital Frog International	275			Promised Land Technologies	97	
	D-Link	32NA 4			PropellerHead Software	97	
	Double R Software	97		<b>S</b>			
1401	DPT	248		1331	RAD Data Communications	32IS 19	
	Dragon Systems	97		1148	Radish Communications Systems	97, 215	
	DragonSlayer Systems	97		1408	Raidtec	248	
	Dual	32NA 4			Rancho Technology	97	
1011	Durand Communications	288		980	RDI Computer	286	
<b>E</b>					Relax Technology	97	
	Electric Banana	97			Right Answers	97	
	EliteGroup	32NA 4		1017	RightFax	289	
1346	Emmerson Computer Power	32IS 24		1338	Roderick Manhattan Group	32IS 22	
	Entropy	97		<b>T</b>			
	Epson	54, 32NA 4		1234	Saber Software	37	
1323	EuroLink	32IS 17			Sapphire Design Systems	97	
	Exodus Software	97			Screaming Technology	97	
<b>F</b>				996	Security Integration	288	
	Famous Engineer Brand Software	97			Shugart Associates	54, 99	
	Far Stone	32NA 4		1314	Siemens Nixdorf Informationssysteme	32IS 16	
1318	FAW	32IS 3			Silicon Graphics	133, 243	
	Federal Express	125, 131			Simply Outstanding Software	97	
1321	Fiskars	32IS 17			Slippery Disks	97	
	Flexus	32NA 4		1024	Soffront Software	289	
1274	Franklin Quest	275			Software Heaven	97	
1235	Frye Computer Systems	37, 32NA 8		1352	Sophos Place	32IS 24	
	Functional Software	97			Spatial Technology	32IS 3	
<b>G</b>					Starfish Software	165, 275	
1325	Galatrek International	32IS 18		1409	Storage Solutions	248	
	Genco Software	97		1410	Storage Tek Distributed Systems Division	248	
1317	Genius	32IS 3			Sun Microsystems	54, 74, 99, 151	
	Glacier Software	97			SurfWare	97	
	Grizzlyware	97		1233	Symantec	37, 275	
	Groundhog Graphics	97		<b>U</b>			
	Grumflish	97		982	Tandberg Data	286	
	Gunning Wordology	97		1232	Tally Systems	37	
<b>H</b>					Tandy	74, 99	
	Hewlett-Packard	54, 79, 165, 239			Tatung	32NA 4	
	Hillary Software	97			TechnoJock Software	97	
	Hitachi	32NA 2		1031	Tektronix	239	
997, 1228	Horizons Technology	37, 289			Texas Instruments	25, 30, 133	
<b>I</b>					Third Planet Software	97	
1032, 1277	IBM	37, 54, 64, 74, 79, 91, 99, 109, 121, 145, 201, 211, 215, 229, 233, 235, 263, 267, 275, 32NA 2, 32NA 8			THOR Manufacturing	97	
1312	ICL	32IS 16			Treacyfaces	97	
1328	ImageStore	32IS 17		1003	Triticom	288	
1327	Imagine Graphics	32IS 18			Two Nerds and a Suit	97	
1322	Incaa Datacom	32IS 17		<b>V</b>			
1012	Infomaging Technologies	289			U-Lead	32NA 4	
	InfoTech	32			Umax	32NA 4	
984	Integrax	287			Up-Safe	32NA 4	
1231	Intel	24, 37, 74, 99, 125, 201, 235, 243, 263			USA Flex	30	
995	Intellicomp Technologies	287		990	U.S. Robotics	215, 287	
1319	Intergraph	32IS 3			Utopia Grokware	97	
1150	Intergraph Computer Systems	243		<b>W</b>			
	International Data	25		1336	Verimaton	32IS 22	
1349	Internet Shopper	32IS 24			Via Technology	32NA 4	
	Intuit	125, 165			ViewSonic	32NA 4	
	IPC Technologies	32NA 2		1329	Vobis Microcomputer	30, 32IS 17	
1023	Iterated Systems	289		<b>X</b>			
<b>J</b>				992	Wacom Technology	287	
1342	Jandel Scientific	32IS 21			Whiskey Hill Software	97	
<b>K</b>				1149	Wildfire Communications	215	
	Kapok	32NA 4		1411	Winchester Systems	248	
	Konpyuta Software PS	97			WordPerfect	37, 54, 64, 99	
<b>L</b>					Working Software	97	
1326	LANart International	32IS 19		<b>Z</b>			
	LeadTek	32NA 4		1316	Ziegler Informatics	32IS 3	
1402	Legacy Storage Systems	248			Zilog	54, 74	
					Zoom Telephonics	215	



# BIX: Your Coach to the Internet!

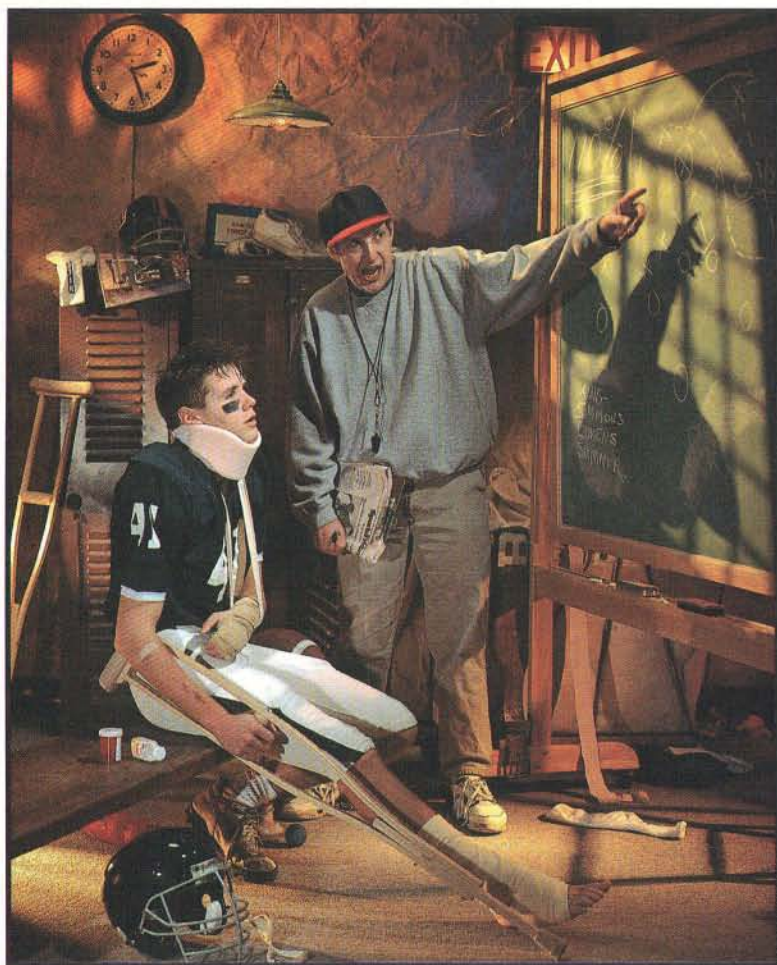


Photo by Dana Simmons

The Internet connects you with more than 10 million people, at universities, companies, and other online services. Now, get full access to the Internet free of charge when you subscribe to BIX! You'll also get expert assistance from BIX moderators who can help you find your way around the Internet.

These experts can guide you through the many services and features available, and help you find the information you're looking for. Anytime you need help, just join our special 'internet' conference and get fast answers to your questions.

As you become more familiar with the Internet, you'll be able to download files from all over the world using FTP, connect to other sites and services through telnet, read and reply to Usenet Newsgroups, access utilities like finger and whois, and much more! BIX and the Internet together provide the largest and most effective technical resource for computing professionals.

And with over 600 local access numbers in the U.S., plus telnet access via the Internet, BIX makes it easy to connect. Try BIX today through our special 5 for Free offer - and become part of the top technical team!

New Member  
**5 hours for Free**  
Introductory Offer

**Give BIX a try with our new 5 for Free Offer!** Join BIX today and get 5 hours of evening and weekend access for free! Take the rest of the calendar month to explore BIX, and then continue for our standard \$13 monthly membership fee. Further details and complete rate information are provided during registration. Using any communications program, dial 1-800-695-4882. At the "login" prompt enter bix. Then at the "name?" prompt enter bix.byte39. If you have any questions, call us at 1-800-695-4775 (voice). Or fax us at 617-491-6642.

Send Internet mail to [info@bix.com](mailto:info@bix.com). Windows users can order BIXnav, our graphical interface for BIX, for easy point and click access. Details are available during registration.

## BIX

**If you can hack it**

Under the 5 for Free plan, daytime rates (\$9/hr.) apply for access during prime time hours. The 5 for Free offer is valid for first-time members only.

**Circle 450 on Inquiry Card.**



# Dreaming of the Future

**Digital technology could help make this a better world. But we've also got to change our way of thinking.**

**D**espite the rapid progression of computing technology, the world faces incredible hazards as we enter a common economic-political vehicle, traveling at an ever-accelerating pace through increasingly complex terrain. Our headlights are much too dim and blurry, and we have totally inadequate steering and braking controls.

Many years ago, I dreamed that digital technology could greatly augment our collective human capabilities for dealing with complex, urgent problems. Computers, high-speed communications, displays, interfaces—it's as if suddenly, in an evolutionary sense, we're getting a super new nervous system to upgrade our collective social organisms. I dreamed that people were talking seriously about the potential of harnessing that technological and social nervous system to improve the collective IQ of our various organizations.

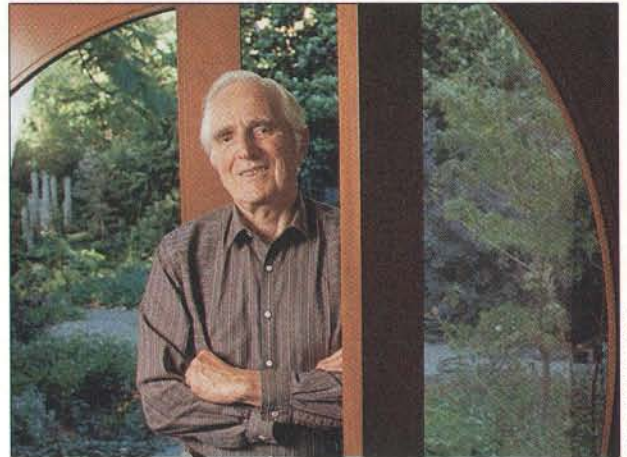
Then I dreamed that we got strategic and began to form cooperative alliances of organizations, employing advanced networked computer tools and methods to develop and apply new collective knowledge. Call these alliances NICs (Networked Improvement Communities). This seemed eminently sensible. The new technologies could enable much more effective distributed collaboration, and the potential for shared risk and multiplied benefits seemed promising.

In the dream, the solution involves giving high priority to the collective capability for a distributed community (or organization) to develop, integrate, and apply new knowledge. We already had this capability, of course; organizations handle new collective problems all the time. But yes, it would be nice if we could be a lot more effective at it. In the dream, this collaborative capability was called CoDIAC, for Concurrent Development, Integration, and Application of Knowledge.

Sounds great. The better we get, the better we get at getting better. Call it bootstrapping. And just think of the important role for technologists.

Although exciting new technology innovations have indeed been introduced within the NICs, the technology efforts have been overshadowed by the concurrent efforts in "human-system" innovation. This includes new skills, methods, collaborative organizational structures, telecommuting, knowledge-worker teams, distributed goal setting, planning and management processes.

One of the ideas computer-oriented folks have contributed is the open hyperdocument system. For this to make a difference, we must shed our outdated concept of a document. We need to think in terms of flexible jump-



DAVID TOERGE © 1995

ing and viewing options. The objects assembled into a document should be dealt with explicitly as representations of kernel concepts in the authors' minds, and explicit structuring options have to be utilized to provide a much enhanced mapping of the source concept structures.

The Web/HTML (Hypertext Markup Language) publishing-browsing landslide has moved steadily toward a highly structured, object-oriented architecture with integrated editor-browser tool sets. But this needs to become the way the majority of people do all their work. Draft notes, E-mail, plans, source code, to-do lists, what have you—all can be hyperdocument pieces, instantly and intrinsically linkable, and with work processes involving fewer and fewer hard-copy printouts.

It has been exciting to watch the emergence of total-quality management, process reengineering, NII (National Information Infrastructure), the World Wide Web, and so forth. But it pains me that we haven't yet put up an explicit CoDIAC target, nor explored how NICs could fly. Since the first of these dreams got fixed in my head, decades ago, I've struggled with the realization that the sooner the world gets serious about pursuing the possibilities, the greater the chance that we can reduce the hazards facing this careening vessel carrying us along.

If the dream of improving human destiny doesn't move people, how about the thought that the companies that adopt the best CoDIAC-improvement strategy will have a significant competitive advantage. Wouldn't you want your group to have the highest collective IQ?

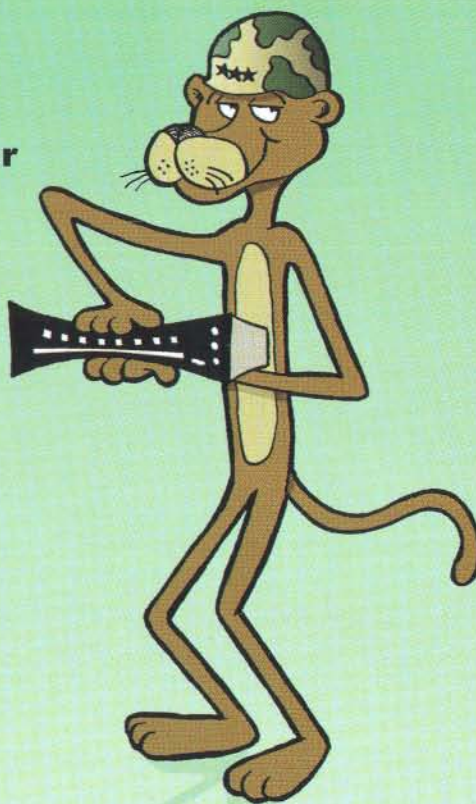
I confess that I am a dreamer. Someone once called me "just a dreamer." That offended me, the "just" part; being a real dreamer is hard work. It really gets hard when you start believing in your dreams. ■

*As a researcher and inventor in the late 1950s and early 1960s, Douglas Engelbart envisioned most of the computing concepts we now take for granted (see the brief biography on page 137). He heads the Bootstrap Institute. You can reach him by sending E-mail to engelbart@bootstrap.org.*



# AutoBoot Technology in a New 'Slimmer' Size!

- Control up to 96 file servers with just 1 keyboard, monitor and mouse
- AutoBoot™ feature boots all attached computers without user intervention
- 1.75" unit fits easily into your computer rack using a minimum of space
- Push-button and keyboard controlled scanning standard
- Control all computers from a second location up to 150 feet away
- Supports all 100% IBM compatible PCs and PS/2 or serial mouse; optional Macintosh and Sun support available
- Rear peripheral access available



COME SEE US AT

Networks Expo, Dallas, TX; Sept. 12-14 1995 Booth #1696 &  
Networld + Interop, Atlanta, GA; Sept. 27-29 1995 Booth #5166

**SLIMLINE™**  
**COMMANDER**

Cybex Corporation  
4912 Research Drive Huntsville AL 35805 USA  
(205) 430-4000 (205) 430-4030 fax

An  
**Inc.  
500**  
Company



IBM, PC and PS/2 are trademarks of International Business Machines Corporation. Macintosh is a registered trademark of Apple Computer, Inc. Sun is a trademark of Sun Microsystems. Cybex, Commander and AutoBoot are trademarks of Cybex Corporation.

Dealer Program Available

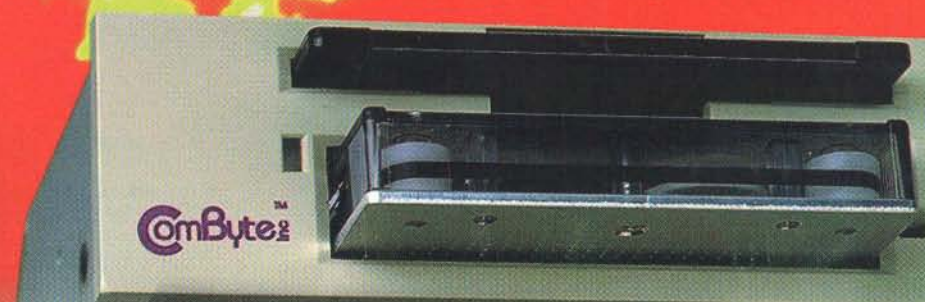
Made in USA

Circle 506 on Inquiry Card (RESELLERS: 507).



# When just a floppy won't cut it!

## Doubleplay<sup>TM</sup> Series I



ComByte<sup>TM</sup>

File sizes are growing  
...how about your floppy?

**Now  
800MB**  
Using Verbatim or Gigatek  
1000' tape cartridges.

- Dual mode drive reads and writes both floppy and tape.
- Doublespeed floppy.
- Industry standard floppy and QIC80 tape formats .
- Copy or move files to tape in Windows File Manager.
- Tape librarian keeps track of files on all your tapes.
- 3 year warranty.

ComByte<sup>®</sup>

4424 Innovation Drive, Ft Collins, CO 80525 • 1-303-229-0660

Available through:

United Kingdom - CMS Peripherals - 0171 704 0202

Germany - CTT - 089 420 9000

Netherlands - ICP - 02940-30636

Circle 547 on Inquiry Card (RESELLERS: 548).